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The Atlantic City Meeting.

The recent convention of the National Electric Light Association at Atlantic City can only be described as an unqualified success. The attendance was large, approximating 1,500 persons; the exhibition was admirable, and the papers were numerous and varied. The discussions were generally practical and useful, and would doubtless have been even fuller if less time could have been consumed by the authors of the papers, in reading them or in presenting abstracts. But this is always more or less of a difficulty at such meetings. Particularly noteworthy was the zest with which the members attended the sessions, neglecting the countless distractions of the famous boardwalk. In this respect the meeting was an agreeable disappointment to many who had feared that the regular work might suffer from the competition of the rolling chair, the auction room and the shooting gallery. As a matter of fact, an excellent programme of business was carried through with a steadiness and an enthusiasm unsurpassed at any other meeting of the body.

In the new president, Mr. Arthur Williams, the association has a man who has spent his whole life in the development of the electric lighting art, and who even more than others has gradually shifted his thought and occupation from the technical side to the commercial. He thus typifies felicitously at this juncture the newer attitude of the association in studying business problems and in exploiting business-getting methods. It is along these lines increasingly that the association must find its mission and career, not overlooking engineering questions but giving at least equal prominence in its transactions to those that relate to the consumption end of the circuit and to the needs of the consumer. Mr. Williams, in this regard, is unusually well equipped to lead the association forces, for some of his best work has been done in connection with the treatment of current-selling questions; the relations of public service corporations to the people, the press and the legislator, and the burning topic of municipal ownership.

Physiological Factors in Illumination and Photometry.

The paper on this subject, read last week before the Illuminating Engineering Society, by Dr. Louis Bell, an abstract of which appears elsewhere, contains some important considerations from the engineering standpoint based on physiological data. We are all hampered in the exact measurement of light and illumination by the fact that light is a purely physiological stimulus and the eye has always to be the measuring instrument of what the eye discerns. As regards our other sensations of warmth, touch, audition and smell, the first two relate to quantities that can be measured by independent apparatus with great precision. Sound can also now be measured precisely, although it has only recently emerged from the same condition as the eye in regard to measurements. Smell remains like light to the eye, immeasurable by any mechanism independent of the nose. Edison's tasimeter is the only independent instrument capable, as yet, of recording a smell, and this only in a very limited and indirect fashion. The paper shows that in feeble illumination, to wit, one-sixteenth of a candle-foot, the human eye becomes blind to

red, and its remaining sensibility is keenest to blue and green. In this condition it is pointed out that the retinal cones have ceased to respond, and only the retinal rods are active in conveying luminous stimuli to the brain. The idea is suggested that the cones, whose action is so necessary to color appreciation, have been developed more recently in evolutionary times, and that the primitive eye had only rods, or blue perceivers. It may possibly be a significant circumstance, in relation to this idea, that sea water rapidly absorbs light from the red end of the spectrum, the last rays to be absorbed as we descend in the ocean being the indigo. The eyes of fishes ought, therefore, to be good blue-perceivers.

The paper suggests that a consumption of 0.5 watt-per-candle, or an illumination of 2 candles-per-watt, is as much as may reasonably be expected from illuminants having a good color. On the other hand, 50 candles per watt might be realized in a light that was off color or that was distinctively colored, and was, therefore, unfitted for indoor illumination. Much progress has yet to be made, however, before even one candle-per-watt can be realized in commercial practice with incandescent lamps. A remarkable relation is given in Lambert's law between the area of the normal human eye pupil and the intensity of the illumination falling thereon. It means that if the intensity of the light falling on the eye be quadrupled, the virtual surface of the pupil will be halved, so that the quantity of light falling on the retina will be approximately doubled. The iris, therefore, does not regulate for constant flux of light on the retina, but only for a rough protection to the retina, by reducing the luminous intensity on the fovea as the square root of the luminous intensity on the eye-ball. There remains a wide field for laboratory investigation connected with the eye and its functions. We require to know what is the relation between the intrinsic brightness of an object and the size of the pupil surveying it, both alone at different distances, and also in conjunction with a background of varied illumination. Again, Fechner's fraction needs to be determined with different colors of illumination. Visual acuity should also be investigated under a definitely varied series of conditions. These and a host of other questions may be investigated by the physicist without encroaching upon the fields of physiology or dissection. The results could not fail to be both of great interest and distinct value in industrial application. Anything which will teach us how to group and place luminous sources with the greatest effectiveness and artistic effect, at minimum outlay and maintenance cost, is of great value to the whole process of civilization.

The Spherical Reduction Factor of Tantalum Lamps.

The tantalum incandescent lamp, like the heathen Chinee, is peculiar. Its filament is remarkable in its drum-cord form, in its physical properties, in its relatively high efficiency and in its power of reconnecting itself after fracture, often refusing to consider itself broken and starting upon a new lease of life, for the moment fresher than ever. But its peculiarities do not stop here. In an article on page 1249 of this number, Dr. Clayton H. Sharp draws attention to a remarkable variation in the space distribution of light from tantalum lamps, not only among different specimens of new lamps, but also in one and the same lamp at different service ages. Thus among nine tantalum lamps, for which the photometric data are published in his article, the difference between the greatest and least spherical reduction factors observed when these lamps were new amounted to nearly 8 per cent of the average, 0.731, representing a probable deviation for any individual lamp of over 2 per cent from this average. The same lamps, when old, had each a probable deviation of 2 per cent from an average 23 per cent greater than the average when new. The article indicates that at least a large part of this increase in the factor with age is due to the horizontal band of black deposit on the inner surface of the globe, which reduces the horizontal candle-power markedly. Not only then is it an even chance that such tantalum lamps will have a spherical reduction factor, when new, outside the limits 0.717 — 0.745, but when they are old the factor will depart from this range and rise to the relatively high value of about 0.9.

The clear indication of these facts, as pointed out in the article, is that tantalum lamps should be metered for luminous intensity by a spherical photometer, if consistent results are to be obtained; for carbon filament lamps rated in mean horizontal candles, but differing only in spherical reduction factor to the extent of 2.5 per cent, are thereby caused to differ in life time by 10 per cent. It would be a great blessing if all lamps could be rated in terms of mean spherical candle-power, only their subsidiary specification giving the candle-power in the tip direction; or in the horizontal direction, as might be desired. Nature will not blind her eyes to the plain truth of the total flux of light or its equivalent, the mean spherical candle-power, of a luminous source, however, inclined we may be to shut our eyes to all light but the horizontal. An interesting fact reported in the article concerning the ageing of tantalum lamps is that their mean spherical candle-power was in several cases greater when they died than when they were new. The suggestion of possibly increasing the mean efficiency of tantalum lamps by enlarging their globes is also interesting from a theoretical as well as from a practical standpoint. Here is a case where the mean free path of tantalum particles, molecules, atoms or corpuscles, whatever they may properly call themselves, has a distinctly commercial bearing. A few years ago one would have thought that the mean free path of a tantalum particle in a certain degree of vacuity and at a certain temperature, was a private property of those minute projectiles that could only be of interest to the dry-as-dust philosopher.

Policy Toward Higher Efficiency Lamps.

Ever since the tantalum lamp appeared as a commercial illuminant of the immediate future central station men have been giving considerable thought to the policy to be adopted toward these new higher efficiency incandescent lamps. Since the tantalum lamp first appeared the new graphitized (so-called metallized) carbon filament lamp has been put on the market in quantities. Now comes the introduction of high-efficiency carbon filament lamps in small units, soon to be followed by the introduction of the tantalum lamp on the American market. Assuming the technical performance of these new small high-efficiency units to be as stated by the manufacturers, some interesting questions come up for immediate solution by every central station company. Manufacturers have doubtless planned wisely in deciding to make lamps take the same watts as existing common incandescent lamps, but giving an increased light. The tendency will then be for customers to take more light and spend the same amount of money as before rather than to reduce bills without increasing their illumination. None but the narrowest-

minded central station manager can fail to welcome increase of lamp efficiency, for every such increase puts in his hands the means of more successfully meeting the competition of gas, gasoline and kerosene. Whether they are welcome or not, they will have to be reckoned with, because if a central station company is unprogressive enough not to introduce a higher efficiency illuminant, it will be placed on its lines by outsiders, for local dealers will soon learn of the higher efficiency obtainable and begin to market these lamps in every community, just as the Welsbach mantle was and is at present being sold.

The astonishing argument was used at the convention that customers will purchase the cheapest lamp without regard to its efficiency. If this were true, gas mantle burners could never have been introduced because open gas jet tips are infinitely cheaper than gas mantles. The American public knows a good thing and there will be plenty of salesmen to help point it out to them. Where a central station is furnishing free renewals the policy must manifestly be based on one of three alternatives: (1) Furnishing the new high-efficiency lamps free. (2) Furnishing them at the difference in price between the new high-efficiency lamps and the common carbon filament. (3) Furnishing only the old type free and charging full price for the new high-efficiency lamps. In view of competition, we are inclined to think that one of the two first-mentioned courses should be pursued. If a company does not furnish free renewals the matter practically takes care of itself, although it will be to the company's interest to push the introduction of high-efficiency lamps for competitive reasons.

NEW ILLUMINANTS.

Professor Clifford's N. E. L. A. paper on this subject gives an instructive, if somewhat undiscriminating, compilation of tests, which will not be without interest to the central station man who desires to compare the claims made in behalf of various commercial newcomers. It is particularly full in data upon various forms of flaming arc. We must take vigorous exception, however, to the author's insisting that the metallic filament lamps are disqualified in their present state of development. It is not necessary, for example, that an enclosed arc lamp should operate in a horizontal position and should be adapted without change for direct and alternating current in order that it should assume commercial importance. No more is it necessary for a Cooper Hewitt lamp to run on 120 volts, or for a Nernst lamp to work on direct current in order to take important place in the art. In point of fact the metallic filament lamps are being used in considerable numbers abroad, and their efficiency is so great that at all usual prices for electricity they are even at present figures cheaper than ordinary carbon lamps at any price. This fact is amply demonstrated by the data given by Mr. Willcox for the graphitized filament lamp, which has an initial consumption of 2.5 watts per candle as against 1 to 2 watts per candle for the various metallic filament lamps now under way. As between a 2-watt lamp and a 3-watt lamp, there is a saving in energy of one watt-hour per candle-power for each hour of burning, which offsets considerable difference in cost of renewals.

With illuminants which greatly reduce the cost of energy, limitations in field of usefulness can be very comfortably endured. Even in the case of the flaming arc with its excessive cost of upkeep, it is worth noting that it is cheaper per light unit than other arcs at all prices of energy usually paid by the private consumer. Such arcs will, therefore, find for themselves useful fields, as for instance in the case of the magnetite arc, which gives a form of distribution particularly well adapted for street lighting. In treating flaming arcs Prof. Clifford might well have pointed out that flaming arcs of low current lose greatly in efficiency. For example, the magnetite arc at 4 amp. requires 1.48 watt per m.s.c.p., while at 7 amp. it gets down to less than 1 watt. Taken as a whole, the data presented for the flaming arcs are very inconsistent, showing the vagaries usually found in commercial tests during a period of exploitation and recrimination. The correlated facts will appear later. We do not at all share Prof. Clifford's fear of high intrinsic brilliancy. It is perfectly well understood that sources having this quality must be used with diffusers; but since every known illuminant that has a claim to present commercial consideration is too bright to be safely used unshaded, the honors are rather even. We note with curiosity the figures furnished for a new street incandescent lamp by Prof. Clifford. He gives data from these lamps rated at 125 watts and 50 mean hemispherical candle-power, showing for the clear lamp 40.66 m.s.cp. and for the frosted lamp 39.52 m.s.cp. We would really like to know who rated those lamps and what kind of frosting it was that absorbed so little light. Frankly, the data on most of the illuminants as given here and elsewhere are badly muddled, and all the questions of efficiency and distribution need overhauling by careful and unbiased experimenters.

A large part of Prof. Clifford's paper is taken up with the consideration of the Moore vacuum tube system, with which he is apparently sympathetic. We cannot discover from the context whether the data upon this subject are original or selected, but they are at least interesting as giving some line on the efficiency of the system, which appears to be moderately good, the consumption claimed being in the neighborhood of 1.5 watts per cp. It is not stated how this candle-power was measured or in what direction, but we should infer that it was, so to speak, the semi-cylindrical candle-power as given normal to the section of tube considered. The scheme of simplifying the installation by using immensely long tubes is certainly interesting, but figures on cost of maintenance would be desirable before endorsing it. Apparently from a patent recently issued to Mr. Moore, some difficulties have been met in maintaining the proper degree of vacuum. Mr. Moore's original vacuum break, really a very pretty and ingenious device, seems to have been lost in the shuffle. One good thing that can be said for the system is that the color of the light can be admirably governed, which is more than one at present can say for the mercury arc. Prof. Clifford speaks cheerfully of the practice of tempering the color of the latter by using it in conjunction with incandescents, but refrains from adding the cost of this amelioration to his general estimate. Lamps like the Moore tube are interesting as showing the opening of a new field of investigation. But upon the whole, considering the time that has elapsed since the beginning of these attempts at gaseous glow lamps, the results up to date are hardly as encouraging as one might wish. The line is worth following, however, for it might take a new turn leading to important results. Meanwhile we certainly have modified arcs and incandescents capable of doing much more efficient work than those now in use; and while still in process of development, they have already assumed too much importance to be overlooked as immediate resources. We hope that the next convention will have brought them further to the front, and that complete information regarding them will be available.

Sections of the Illuminating Engineering Society.

The Illuminating Engineering Society at a recent meeting of the council disposed of a question which had commenced to assume a threatening aspect, namely, the relative status of the New York meeting and of the meetings of the several branches of the society. At present there are branches of the society in Boston, Chicago and Philadelphia, and in these places it appears that considerable dissatisfaction had arisen on the score that the New York meetings were conducted as meetings of the society at large, thereby giving a dubious status to the branch meetings. That the council recognized there was cause for complaint is evident from the adoption of the following resolutions, which were carried unanimously, and presented June 8 at the New York meeting:

1. In order to distribute as equitably as possible the benefits and privileges of membership in the Illuminating Engineering Society, the organization of sections is authorized in any city or locality where the local membership is fifty or more.

2. The membership of New York City and vicinity shall be organized as a section, to be known as the New York Section of the Illuminating Engineering Society.

3. Each section organized shall nominate and elect for the local conduct of the section a chairman, two vice-chairmen and a secretary.

4. The expenses of sections incurred for postal card notices and stenographic report of discussions shall be paid from the general fund of the society. Other expenses than these, such as rent of auditorium, if any, must first be authorized by the council.

5. In order to insure that the conduct of sections shall always be in conformity with the general policy of the society, any proposed action of a section not relating to the holding of meetings and the discussion of papers, shall be submitted to the council of the society for approval prior to be being put into execution.

6. In order to facilitate the timely issue of the *Transactions* the meetings of all the sections shall be held before the 20th of the month.

7. The secretary of each section shall distribute the stenographic reports of discussions to members of the section for correction, and forward the corrected report to the general secretary of the society.

8. The sections shall abide by the Constitution of the society and conform to the regulations of the council.

At the New York meeting on June 8 it was announced that the total membership of the society was 572. It was also announced that a badge for the society, designed by Mr. Waldo S. Kellogg, member, had been adopted, and could be obtained by members on application on payment of $3.00, this sum slightly exceeding the cost of the badge.

Illuminating Engineering in Great Britain.

Our British contemporary, the *Electrical Magazine*, in commenting on a series of articles in its columns by Mr. L. Goster on "The Need for the Illuminating Engineer," expresses the hope that its readers will respond heartily to the appeal for aid in the formation of a British Illuminating Engineering Society. No time, it says, should be lost, as the present position of illumination demands co-ordinate interest and co-operative effort for its establishment on an authoritative basis in this country. "America has led off well. Already it can boast a society and two independent journals devoted to the subject. The state of affairs here needs both of these, and just as soon as they can be fashioned from the materials at disposal. We want the gas and oil men as well, and hope they will stand by the movement, as their interests are likely to be safeguarded equally with those of other illuminants represented. We have now done with the talking. The sooner the practical business is got down to the quicker the end in view will be attained."

That in this country the formation of a society to foster the interests of illuminating engineering was entirely justified, is shown by the rapidly growing membership of the present society, which is now little short of 600 and promises to reach 1,000 by the end of the year, by the high character of the contributions available for its *Transactions* and by the lively interest in the meetings as manifested in the discussions. Our British friends should not delay getting into line with this latest branch of technical specialization.

The Institute British Trip.

Note has already been made in these columns of the hospitalities which the Institution of Electrical Engineers of England proposes to extend this month to visiting members of the American Institute of Electrical Engineers. The subjoined is the list of the A. I. E. E. participants, and it is matter of regret that more of the members are unable to avail themselves of this opportunity: President Wheeler, Mrs. Wheeler; J. W. Lieb, Jr., Mrs. Lieb; Ralph W. Pope, E. W. Stevenson, Mrs. Stevenson; Morgan Brooks, Henry Brooks, F. B. Crocker, C. A. Perkins, Mrs. Perkins, Miss Perkins, Miss Perkins; A. E. Kennelly, C. H. Sharp, J. H. Siegfried, F. H. Taylor, Mrs. F. H. Taylor, C. L. Edgar. The following foreign members of the Institute, ditto: W. C. Burton, J. R. Crawford, Mrs. J. R. Crawford; W. H. Donner, E. T. Goslin, Kaleb Hedin, Richard Heinrich, W. S. Hunt, Paul Letheule, J. W. McCrosky, Charles H. Merz, Edwin J. Murphy, M. Osborne, Mrs. Osborne; Edwin S. Reid, Mrs. Reid; Harrison Smith, Herbert Laws Webb, Ragnar Wikander, A. E. Winchester, J. G. Lorrain, R. H. Zafitz.

Single-Phase Equipment for Richmond and Chesapeake Bay Railroad Company.

In the early days of electric railroading, Richmond, Va., was among the first to install a trolley railway and in the year 1888 the Sprague system was installed and successfully operated in the city on a commercial basis. This glimpse of early railroad history is called to mind by the fact that Richmond is taking the same initiative by adopting the latest development in railway traction, the single-phase, alternating-current system. To this end the Richmond & Chesapeake Bay Railway Company has been incorporated, and, in accordance with its plans, about 15 miles of track will be equipped immediately with single-phase apparatus. Eventually this single-phase road will extend from Richmond to Chesapeake, but the portion about to be electrified comprises that part lying between Richmond and Ashland. The contracts for the entire equipment of this section have been let to the General Electric Company.

The line in general will follow the plans which several roads in the Middle West have adopted, but the trolley voltage will be higher. The catenary method of suspension will be used, adapted for a trolley potential of 6,600 volts. Each of the cars will be shipped with four single-phase motors with multiple-unit control. The air brake system will be of the combined straight and automatic type with motor compressors.

Power for the operation of the new road will be furnished by the Virginia Passenger & Power Company and the arrangements for furnishing the single-phase current are of especial interest. Two generating sets will be furnished, both to be operated ordinarily by water power, but arranged for electrical drive when that is necessary. The first unit will consist of a 750-kw, 6,600-volt, three-phase, 25-cycle generator, mounted on the same shaft with a 750-kw, 2,300-volt, 60-cycle, three-phase generator, the shaft being extended at one end for connection with a water wheel of sufficient power to drive both generators at their rated output.

The second set will be made up of a 25-cycle, 6,600-volt generator, a duplicate of the first, but instead of being mounted with a 60-cycle machine, this generator will be mounted on the same shaft with a 750-kw, 550-volt, direct-current machine. When there is sufficient water to operate all of the water wheel generators in the station, these sets will be driven by the water wheels; if at any time there is insufficient water to drive the generators or flood conditions render it advisable to close the gate

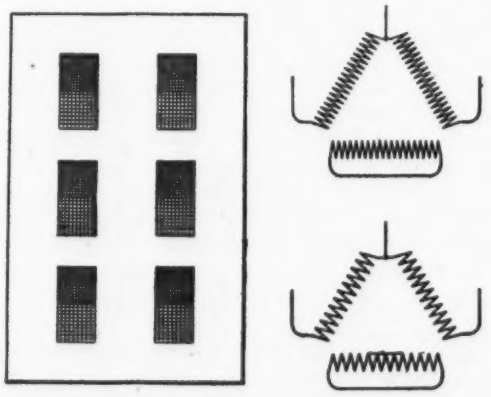
valves, the sets will be disconnected from the wheels and operated as straight motor generator units. In their respective cases the 60-cycle generator will run as a 60-cycle synchronous motor and the 550-volt machine will operate as a direct-current motor. Power for driving the motor and of the 25-cycle sets in this way will be obtained from the engine-driven units of the Virginia Passenger & Power Company, already installed. When the motor generator units are operated as water wheel-driven machines, the 60-cycle generator will be operated in parallel with the present 60-cycle machines, and the 550-volt machine in the other set will run in multiple with the present 550-volt machines. The 750-kw, 25-cycle generators in each set will, for the present, be operated as single-phase machines and will supply current directly to the trolley of Richmond & Chesapeake road at 6,600 volts.

In addition to the main apparatus outlined for the road, there will be a lighting station at Ashland. This will consist of a 100-kw, 2,300-volt, 60-cycle, three-phase generator mounted upon a common base with a 150-hp, 440-volt, 25-cycle, single-phase induction motor. This set will be operated from the 6,600-volt trolley through a 150-kw, single-phase, oil-cooled transformer. The motor generator set will be provided with a direct-connected exciter mounted on an extension of the shaft. The voltage will be controlled by a Tirrill automatic regulator, which will insure a uniform voltage at the generator end of the lighting service, regardless of the fluctuating trolley voltage.

The Richmond & Chesapeake Bay road to be so equipped will practically parallel the Richmond, Fredericksburg & Potomac steam road from Richmond to Ashland, and it is the intention of the trolley company to maintain a fast schedule between these two points, operating cars at very frequent intervals.

Operation of Disabled Three-Phase Transformers.

It has frequently been urged against the use of a three-phase transformer with interlinked magnetic circuits that if one or more windings become damaged by short-circuiting, grounding, or through any other defect it is impossible to operate from the undamaged windings of the other phases, as would be the case if a single-phase transformer were used in each phase of the multiple-phase system. In a patent issued May 22 to Mr. W. S. Moody means are described for operating such a transformer exactly as one would operate the remaining undamaged single-phase transformers used for three-phase work. A view of a shell-type,



FIGS. 1 AND 2.—OPERATION OF DISABLED THREE-PHASE TRANSFORMERS.

three-phase transformer is given in Fig. 1, while Fig. 2 shows the method of using the coils when the windings of one phase become damaged.

The damaged transformer windings are electrically separated from the other coils. The high potential winding of the damaged phase is short-circuited upon itself and the corresponding low potential winding is also short-circuited upon itself. The windings thus short-circuited will choke down the flux passing through the portion of the core surrounded by them without producing in any portion of the winding a current greater than a small fraction of the current which would normally flow in such portion at full load.

President Williams of the National Electric Light Association.

Mr. Arthur Williams, who has just been elected president of the National Electric Light Association, was born August 14, 1868, and is the son of a well-known Methodist Episcopal clergyman. He was educated in public and private schools in New York, Hartford, etc., and in 1885 entered the service of the New York Edison Company as assistant in the chemical meter department. He became electrician of the company, then operating only the old Pearl Street station, 1887-8, and in 1888 was made

PRESIDENT WILLIAMS.

the superintendent of the third district. The following year he became superintendent of the underground department. About 1890 he was appointed as general inspector, and in 1893 general agent; and he has exercised the functions of both these departments ever since. Such a career is remarkably well rounded and embraces a wealth of experience rarely enjoyed by a man still so young. Mr. Williams is also vice-president of the Yonkers Electric Light & Power Company, of whose system a description appeared in these pages on April 21.

Mr. Williams has from the first been interested in the work of the National Electric Light Association, and has already served as second vice-president, 1904-5, and first vice-president 1905-6. He has also been active in the Association of Edison Illuminating Companies. In 1901-2 he was president of the New York Electrical Society and had a very successful year of office. He was elected as an associate member of the American Institute of Electrical Engineers in 1897. His broad interest in social affairs is shown by his membership in the Union League Club of New York, the Brooklyn Riding and Driving Club, the National Arts Club, the Electrical Club, and the Yonkers City Club.

Variable-Pole Self-Starting Single-Phase Induction Motor.

It is well known that a polyphase motor requires a higher secondary resistance when starting than when running in order to insure a large starting torque. In a single-phase motor it is still more important that the secondary winding have a relatively low resistance when running, since the maximum torque or "pull-out" torque of the motor is dependent upon the amount of resistance in the secondary circuit, while in a polyphase motor the pull-out torque is independent of such resistance. The accompanying illustration shows a scheme proposed by Mr. B. G. Lamme in a patent issued May 22, for obtaining a high resistance under starting conditions without the employment of short-circuiting devices. The secondary winding is of the squirrel-cage type, having high-resistance end rings at certain points along which are connected low-resistance conductors. The primary

winding is arranged to produce twice as many magnetic poles at starting as when running. The low-resistance secondary connectors are attached at points corresponding approximately to

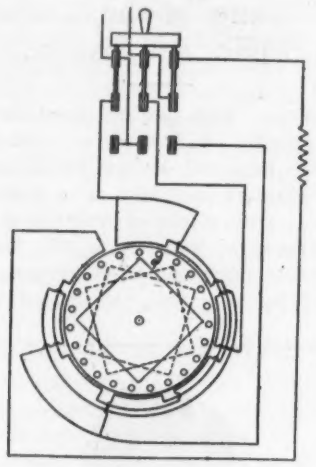


DIAGRAM OF MOTOR CIRCUITS.

the polar pitch when the primary winding is connected for the smaller number of poles; that is, for the running conditions of the motor. Thus low-resistance secondary circuits are provided for the motor under running conditions and relatively high resistance secondary circuits for starting conditions.

Regulation by a Municipality of Maximum Rates for Lighting.

An interesting and important report has been filed by the special master appointed by the Circuit Court of the United States for the Southern District of Ohio, Eastern Division, in the complaint of the Columbus Railway & Light Company vs. the City of Columbus. The principles which have been contended for in this case have been that in the regulation by the municipality of a maximum rate for electric light, the authorities must consider the maximum cost of rendering the service to any substantial class of customers; and that the cost of service must be recognized as being based on the hours of use. These points have been established by the master's findings in both fact and law.

Under the provisions of the act of 1904, giving city councils power to regulate rates, for light, water, etc., the City of Columbus passed an ordinance fixing the rate for electricity for electric lighting at 5 cents the kilowatt-hour. Prior to that time there was no rate fixing ordinance. Thereupon the complainant brought action by a bill of equity, alleging that if the ordinance were enforced it would sustain a large annual deficit and would never be able to derive any revenue from its investment. The ordinance was also in violation of contract rights guaranteed to the company and "if enforced will deprive complainant of its property without due process of law, and will take the property of complainant for public use without compensation; and such ordinance is in contravention of the Constitution of the United States." The complainant in view of the fact that it had no adequate remedy at law asked for an injunction to restrain the city from enforcing the ordinance, and secured a temporary injunction.

The case having been referred to the master, he made an elaborate investigation of the question for the court and has now filed a voluminous report, which deals with decisions as to rate regulation on railroads, etc., and then discusses in detail the evidence presented as to the investment in the plant, operation, expenses, depreciation, etc. Then taking up the effect of the proposed rate the report says:

"The total earnings of complainant for the year 1904, $333,000 in round numbers, were based on the net maximum rate during that year of 10 cents. Had the maximum rate during that year been 5 cents, as fixed by the ordinance, the difference between the amount actually received and that which would have been received under the maximum rate prescribed by the ordinance, is admitted to be $33,000. Deducting this $33,000 from the net amount, after providing for the annual depreciation, the net amount left applicable to rental charges would have been $26,500, or $69,000 less than sufficient to pay that rental. The evidence shows that while the maximum rate charged by complainant during the year 1904 to its customers was 10 cents, competition with rival companies supplying light and power and competition from natural and artificial gas, compelled complainant, in order to maintain its business in certain quarters of the city, to fix a voluntary maximum rate of 5 cents, and in other quarters to vary its maximum rate between 5 cents and 10 cents. The proof shows that out of 3,134 customers only 564 were charged the maximum rate.

"The section of complainant in so meeting competition, even though it might have resulted in temporary loss, an action similar to that of many other corporations both public and private, taken voluntarily in order to hold business, and in the hope of ultimate profit, should have no legal effect upon determining the issues in this case. It would seem to be axiomatic as a legal proposition that while one may voluntarily if he so chooses, devote his property to the public service without compensation, he cannot by law be compelled to do so."

The report goes into an analysis of the classes of the 3,134 customers, and shows that the total cost to the company of serving one-hour customers was 12.434 cents per kw-hour, two-hour customers 6.869 cents, and three-hour customers 5.013 cents. It is held, upon very extensive argument, that this would be unfair and confiscatory. The conclusions of fact are as follows:

The total amount of money expended upon complainant's property up to December 31st, 1904, amounted to..	$2,000,000	
The fair value of complainant's property in the year 1904, was	1,650,000	
The gross earnings of complainant during the year 1904 were	333,000	
Of this amount there was earned from rates in excess of 5 cents per kw-hour	33,000	
The operating expenses of complainant during the year 1904 were	191,000	
The proper amount to be added to such operating expensse for depreciation is 5 per cent. upon the value of the property, or	82,500	
The value of meters, and arc lamps included in the valuation of complainant's property is	165.000	
The maintenance and renewal of arc lamps and incandescent lamps charged to operating expenses during the year 1904 amounted to	25,000	
The cost, without depreciation, of furnishing 1580 one hour consumers during the year 1904, per kilowatt-hour, was		5.394c.
The cost, including depreciation, was		8.594c.
The cost, without depreciation, for furnishing 803 two hour consumers during the year 1904, per kilowatt-hour, was		3.349c.
The cost including depreciation was		4.949c.

Based upon this, operating expenses, including depreciation upon the valuation found for the property of complainant, under the maximum rate provided by the ordinance as applied to its receipts during the year 1904, the company would have received as compensation less than 2 per cent upon its investment.

The conclusions of law are subjoined: 1. The court has jurisdiction of the case and power to grant the relief prayed for. 2. Meters, arc lamps and incandescent lamps are a proper part of the property account of complainant, and their repair, renewal and maintenance is a proper charge against its operating expenses. 3. The amount which complainant could have earned upon a fair valuation of its property during the year 1904, had the ordinance been in force, was not a fair compensation within the meaning of the law, and for that reason said ordinance, if enforced, would have deprived complainant of its property without due process of law. 4. The fact that 75 per cent of complainant's customers under the rate fixed by the ordinance would receive their light at cost, or less than cost, including depreciation, is in itself a violation of the constitutional rights of complainant, and deprives complainant of its property without due process of law. 5. For the reasons above stated, the ordinance of July 5, 1904, is unconstitutional in that its enforcement would deprive complainant of its property without due process of law, and deny to complainant the equal protections of the laws, and, therefore, the injunction should be made perpetual.

Some Physiological Factors in Illumination and Photometry.

In a paper presented at a meeting of the Illuminating Engineering Society, held in the Edison Auditorium, New York City, on June 8, Dr. Louis Bell pointed out some of the bearings of physiological optics upon practical illumination, its measurement and the limitations of its efficiency. According to Fechner's law, the human eye can perceive a fixed fractional difference of illumination, irrespective, within wide limits of its absolute amount. This fraction varies in general from about 1 per cent to about 0.55 per cent assuming ordinary sources of illumination and normal eyes. Now for the purposes of practical lighting, the illumination should be generally kept within the range for which Fechner's law holds good, and once well within that range of normal sensibility nothing is gained virtually by increasing the strength of the illumination, so far as difference of luminosity is concerned. Experience shows that at one or two foot-candles the eye is working so near its normal sensibility that further increase in illumination is of relatively very small value.

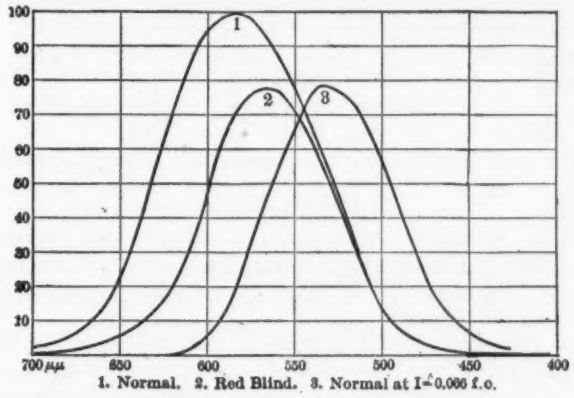
The essential point in good seeing, however, is that the values here specified should be those affecting the eye and not merely those by which objects are illuminated. Since objects are each in virtue of differences of reflected light the illumination which affects the eye is determined by the coefficients of diffuse reflection of the objects in the field of view. The surface observed acts as a secondary source of illumination, and for details small compared with the normal visual distance the law of inverse squares holds, hence the tendency to get the eyes close to the work in insufficient illumination. In weak light, say 0.1 or 0.2 foot-candle, variations of shade are perceived only with difficulty. At 0.5 foot-candle conditions are very greatly improved and useful illumination begins, and above 1 foot-candle they may be considered normal, unless close detail is concerned, in which case more light is of some assistance. But the controlling factor in practical illumination is the luminosity of the colors concerned, producing apparent color relations which entirely mask the real ones already described. Given, therefore, the general kind of work which is to be done under artificial light and one can reckon from general physiological and physical data the approximate intensity of illumination required. The lowest permissible illumination is, of course, for coarse work on approximately white objects, the highest for close discrimination of detail and shading in dark objects.

For very weak and very bright illumination the effect of pupillary diameter must be taken into account. So far as objects in the visible field are concerned there is every reason for keeping the illumination received from them quite near to the critical amount, and so long as this is done the pupillary diameter, so far as these objects are concerned remains reasonably constant. The iris diaphragm of the eye responds by reflex action to light and other stimuli, varying in diameter from hardly more than a point in very intense light to a width in complete darkness so great that the iris actually retreats under the margin of the cornea. If a bright light causes the pupil to contract abnormally the illumination available from objects in the field of vision is cut down and the normal sensibility of the eye may be greatly reduced. Suppose, for instance, an eye receiving 1 foot-candle at its normal pupillary diameter, in such case not far from 4 mm. Let now a light enter the field of vision bright enough to contract the pupil to 2 mm., and the effect is the same so far as the general field is concerned, as if the available illumination were cut down to 0.25 foot-candle, which is too low for decent seeing. Hence, the importance of keeping bright radiants out of the field of vision.

The actual relation between pupillary aperture and intensity of illumination has been investigated with somewhat various results, much depending on the state of adaptation of the eye. In examining the classical experiments of Lambert on this subject a simple approximate relation appeared between the area of the pupil and the illumination, to wit: that the former varied with the reciprocal of the square root of the latter. It is probable that the pupillary aperture is affected by the intrinsic brilliancy of the source as well as the illumination from it, but the exact relation remains undefined. This much is certain, that a light of too high intensity or intrinsic brilliancy within the field of vision tends to defeat its own purpose by automatically stopping down the iris. This is quite apart from the well-known and serious effect of such lights in causing retinal irritation, to which the loss of many an eye may be attributed. Any violent contrast in the field of vision is objectionable for the same reason, in less degree, so that if conditions are such as to require powerful illumination in a part of the field a very bright background in the rest of the field should be avoided, it being preferable to have there merely enough light to avoid excessive contrasts.

As most objects are colored, the relative luminosities of various colors are important considerations in illumination. That the eye is affected by various colors in very different degrees is well known, and the fact is responsible not only for great difficulties in photometry, but also for serious limitations on the possible efficiency of illuminants. Fig. 1 shows several luminosity curves from the experiments of Abney. Curve 1 is that for the normal human eye taken with fairly bright light. It has a strong maximum in the yellow of the spectrum, while in the scarlet on the one hand and the full green on the other the apparent luminosity has fallen to half the maximum. In the deep crimson and the blue respectively it is below a quarter and rapidly falling. While the luminous part of the spectrum lies mainly between wave lengths 700 $\mu\mu$ and 400 $\mu\mu$ the effective part of it lies between wave lengths 630 and 530. Energy outside these limits is for the most part wasted so far as vision is concerned.

At first sight, therefore, the eye would seem to be very inefficiently organized. Such, however, is not the case, for the eye has been evolved not for artificial light, but to meet the exigencies of natural light, and its point of maximum luminosity falls very near to the point of maximum energy of the solar light, in fact, between that and the maximum energy point for skylight, so that the adjustment of the sensibility for natural conditions is excellent. Moreover, were it not for the adjustment of the eye for a sharp maximum of sensibility, we should be totally unable to see clearly on account of the effect of chromatic aberration. When the eye is accommodated for yellow light, images due to deep red and deep blue light are badly out of focus and were they comparable in brightness to the yellow image, near vision would be very indistinct, and aside from this we should lose much of the contrast which helps to render objects visible.



1. Normal. 2. Red Blind. 3. Normal at I = 0.066 f.c.

FIG. 1.—LUMINOSITY CURVES.

As was long ago noted by Purkinje and Dove, the relative luminosity of different colors is greatly affected by the absolute intensity of the illumination, a fact at once curious in itself and in photometry very troublesome. Curve 3 of Fig. 1 shows the relative luminosities for white light of an intensity of about 0.066 foot-candle. Its maximum lies in the full green instead of the yellow and the luminosity for yellow and red is very low. To be strictly comparable to Curve 1 it should be plotted with the same maximum, but its shape plainly shows that in light of so low intensity, the normal eye is red blind. Curve 2 shows the luminosities in an actual case of color blindness. Red blindness varies in amount, but no case is so severe as that of the normal eye in weak light.

The comparison of colored lights involves this phenomenon to a very serious extent, and in particular all extinction methods are vitiated by it save when used merely for the comparison of lights of similar color or for the actual measurement of very low intensities. In fact, any photometric device which can be used on

colored lights with coherent results by both the normal and the color-blind, owes its apparent efficacy to disregard of part of the spectrum generally useful.

Now in using artificial illuminants the real usefulness of the light evidently depends upon the amount of energy which falls within that part of the visible spectrum to which the eye is reasonably sensitive. In fact, the photometric principle laid down by Crova, of comparing lights by their respective components in the neighborhood of 590 $\mu\mu$ wave length had much to recommend it in dealing with sources which give a continuous spectrum. The position of the energy maximum in the spectrum of an incandescent body is a function of the temperature, and unfortunately the temperatures available in flames, incandescent lamps and so forth are too low, say, 1,800° to 2,200° absolute, to place this maximum where it will do the most good. In fact, to put the maximum where it ought to be requires the solar temperature itself. Fig. 2, from the researches of Nichols, gives with arbitrary ordinates the distribution of energy in the visible part of the spectrum for various familiar sources of light. The first three curves are for ordinary incandescent solids and bear a striking resemblance to each other. Curve 4, from the electric arc, shows relatively more blue and less red than the others, thus corresponding to its higher temperature. Curve 5, from a Welsbach mantle, shows a considerable departure from the distribution of the normal incandescent body, due not to enhanced temperature, but to powerfully selective radiation. It indicates a very high luminous efficiency, since the maximum lies within the visible spectrum. Curve 6 is the solar radiation, which is from a temperature so enormous that the maximum is pushed up into the orange. Were one sure that the radiation is quite non-selective a pretty close value for the solar temperature could be obtained. As it is, it is only safe to say that the temperature is probably between 5,000° and 6,000°.

Now these curves are, so to speak, the mere fag-ends of the total energy curves. Fig. 3 shows their relation to the whole radiation. Curve 1 shows the immense advantage in efficiency of the solar radiation. All ordinary illuminants give curves lying between 2, the Hefner lamp and 3, the acetylene flame, which is not far from the result given by the arc, the only artificial light of higher temperature.

The efficiency of an illuminant in the sense in which the expression is ordinarily used is the ratio between the luminous energy and the total energy. In this estimate the luminous spectrum is commonly taken as beginning at wave length 760 $\mu\mu$. All of it that is good for anything, however, lies practically between the limits shown on Fig. 3.

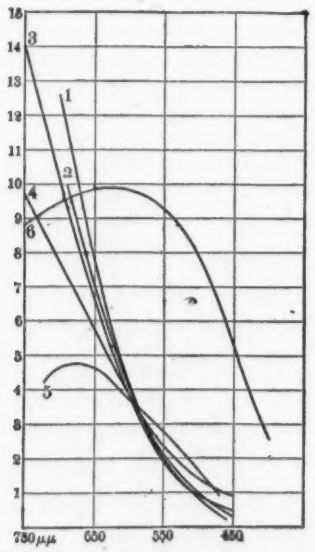


FIG. 2.—DISTRIBUTION OF ENERGY IN VISIBLE SPECTRUM.

Angström has found for the particular energy curve of the Hefner lamp that one square centimeter of surface 1 m. from the flame receives 8.3 ergs per second of luminous energy, which gives for this particular source a luminous efficiency of 0.9 per cent. Other things being equal, if all the energy were converted into light on the basis of this mechanical equivalent of light, we should obtain for a radiation wholly within the visible spectrum, a candle at a consumption of 0.115 watt. But the visible light is really the summation within the visible spectrum of each element of energy multiplied by its corresponding coefficient of luminosity, and this summation is very different for different energy distributors. Nichols, from the application of Crova's criterion that lights of equal intensity at wave length of 590 $\mu\mu$ are equal, has made some most interesting approximations to the mechanical equivalents as derived from other illuminants reaching for sunlight 4.85 ergs per second and for the Welsbach on account of its selective radiation, as low as 4.39 ergs per second.

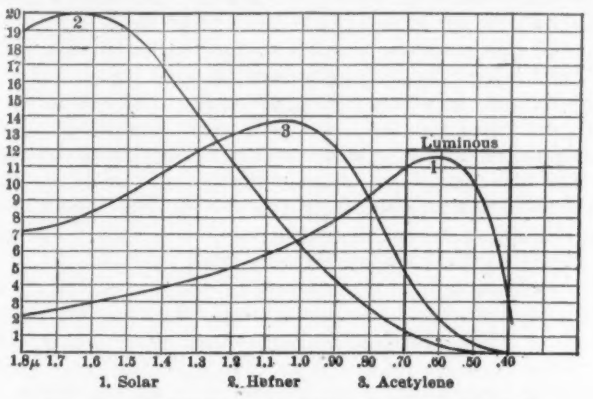


FIG. 3.—DISTRIBUTION OF TOTAL RADIANT ENERGY.

A rigorous summation made as above would change these quantities somewhat, but the main point of the matter is that if one could confine radiation to the visible spectrum with as good a distribution as is given by the Welsbach or by sunlight one could secure artificial light at a consumption of about 0.06 watt per candle-power. This, however is not the limit, for if in addition one could crowd all the radiation into the neighborhood of wave length 590 $\mu\mu$ one could get light at a consumption of approximately 0.01 to 0.02 watt per candle-power, which is about the theoretical minimum. This would, however, be practically monochromatic light by which color vision would be impossible.

The flaming arc is the most efficient illuminant yet found, and M. Blondel has been able to obtain from it a mean spherical candle at a consumption of 0.1 watt, due to the very high luminosity of the two calcium fluoride bands near to wave length 600 $\mu\mu$. The light, however, has a large color error which can be corrected only by a considerable sacrifice of efficiency. Undoubtedly, a discontinuous spectrum gives the best chance for high efficiency, but only at the cost of serious color errors. Even if one could obtain a discontinuous spectrum of the three primary rays only, it would be at a sacrifice, and there would be some doubt of its value as an illuminant on account of chromatic aberration in the eye.

Could one steal the fire-fly's secret, the result would be, if Langley's experiments correctly represent it, a light of high efficiency it is true, but of about the color of a superannuated Welsbach. From all appearances, it will be extremely difficult to do much better than to obtain a candle at a consumption of 0.5 watt with an illuminant of reasonably good color quality.

DISCUSSION.

The discussion was opened by Dr. Percy Friedenberg, president of the Harlem Medical Association, who spoke from the viewpoint of the oculist, of the general effect of light on the eye. After explaiinng the ability of the eye to detect certain differences in intensity of illumination, he stated that the amount of light admitted to the eye depends upon the size of the pupil, and objects can be seen clearly even when the pupil is much contracted. The pain experienced when passing to and fro between dimly lighted and brilliantly lighted rooms is due to the attempt of the pupil to adapt its opening to the illumination. The most perfect illumination is that in which there are no marked changes in brilliancy. In regard to the effect upon the vision and the fatigue of the eye, the comparison of lamps is more largely a question of distribution than of quality or quantity. The pain felt when even a shaded lamp is placed near the eye is due less to the brilliancy of the illumination than to the heat of the lamp, which tends to dry off the surface of the eye. Lamps should always be placed so that no light falls directly into the eye; only the object

to be seen should be illuminated. Any form of monochromatic light is disadvantageous, because it tires one set of eye nerves without using the others.

Dr. N. J. Hepburn, of the Manhattan Eye and Ear Hospital, remarked that too much light is worse than too little; a well subdued light is best of all. Experience shows that the yellow light, such as is obtained from a kerosene lamp, is much less fatiguing to the eye than the white light, which comes from a brilliant incandescent lamp. A pleasing effect is obtained by using a light yellow or gray color for the walls of rooms, the lamps being concealed.

Dr. William S. Dennett expressed his approval of the method used in illuminating the Edison Auditorium, where all of the lamps are either completely concealed or are covered with frosted globes, most of the light being reflected from a white ceiling. The prime requisite in illumination is uniformity of distribution and constancy of intensity. It cannot be too strongly urged that light of great brilliancy should not strike the eye directly.

Mr. W. D'A. Ryan expressed the opinion that too much illumination is not now being used, and that even though the light be increased three or four times it will not be excessive. A law should be passed to prohibit the placing of the lamps in public assembly halls where the light will strike the eye directly. In explanation of the pleasing effect obtained from yellow light, it may be stated that an incandescent lamp which gives a yellow light is operating at a low intrinsic brilliancy.

Mr. J. R. Cravath believed that the statement by Dr. Bell at or near one or two foot-candles the eye is working so near its normal sensibility that further increase in illumination is of relatively very small value and can be used as a criterion of general illumination for ordinary purposes. Such intensity, however, is not sufficient for draughting, where at least 10 foot-candles should be used. For reading purposes it is frequently restful to have the room as a whole less brilliantly lighted than the book, though the contrast should not be too great.

Mr. E. L. Elliott expressed the opinion that even when lamps are high up along the walls the effect is disagreeable to the eyes so long as the lamps remain within the line of indirect vision.

Mr. V. R. Lansingh stated that the Government now specifies a low surface brilliancy from diffusing globes which surround incandescent lamps, namely, ⅙ cp per square inch of diffusing globe.

Mr. N. J. Neall.

Newitt Jackson Neall was born in Philadelphia, February 7, 1875, and attended the public schools in that city until graduation from the Boys' Central High School. Following this came four years in a special apprentice course with the Pennsylvania Railroad at Altoona, Pa., intended to train young men for positions of responsibility in railroad work. Feeling at the end of his apprenticeship the need of a further engineering training, Mr. Neall entered the Massachusetts Institute of Technology as a student in the mechanical engineering course. While pursuing this course electrical engineering made a most strong appeal to his taste; from this latter course he was graduated in 1900 with the degree of S. B.

Immediately after graduation Mr. Neall associated himself with the Westinghouse Electric & Manufacturing Company at East Pittsburg, Pa., becoming later assistant to Mr. Percy H. Thomas, engineer of protective apparatus for high-voltage transmission lines. When Mr. Thomas went over to the Cooper Hewitt Electric Company Mr. Neall assumed the responsibility for this section of the engineering department. In connection with this work Mr. Neall traveled extensively over the United States, and has kept in close touch with the latest developments of high-tension engineering. By arrangement Mr. Neall has lately enjoyed the advice and co-operation of Mr. Alexander J. Wurts, the well-known authority on, and inventor of, lightning protective devices.

Mr. Neall has contributed to the engineering press a series of semi-historical articles; he has recently presented a paper before the American Institute of Electrical Engineers, entitled, "Performance of Lightning Arresters on Transmission Lines," and took part in the discussion of papers presented before the high-tension committee of that body, as well as of those presented before the International Electrical Congress at St. Louis. Mr. Neall is thoroughly conversant with and greatly interested in the German language and German technical literature, having visited Germany to extend his knowledge thereon, and later was elected a member of the Electrotechnischer Verein, of Germany, and of the Deutsch-Amerikanischer Techniker-Verband.

Mr. Neall recently resigned his position with the Westinghouse Company to work further afield, and has now opened an

MR. N. J. NEALL.

office in Boston. He will make a specialty of lightning protective apparatus, in connection with which so few men are working independently, and also engage in a more restricted sense on local problems of alternating-current applications, particularly for high-voltage installations.

CURRENT NEWS AND NOTES.

MARRIAGE BY TELEPHONE.—A telephonic marriage ceremony was performed recently at Pearlington, Miss. The minister lost his way and returned home about 11 at night, when he was called up by the anxious couple, who were miles away, and the ceremony was performed over the telephone line.

RESULTS OBTAINED WITH GAS POWER.—The Franklin Electric Company, Franklin, Pa., has recently decided to increase its gas power lighting plant, and has accordingly placed an order for a Westinghouse 125-hp, three-cylinder vertical type gas engine. The company has operated a gas engine plant for several years, and has done away entirely with the use of steam. The present plant consists of five belted units of similar type, which have been giving uninterrupted service since the change over from steam to gas, and the present order is the outcome of the successful experience which the company has had with gas power. Natural gas is used in the plant, obtained from local wells, and is exceedingly rich; both the gas and oil occurring in this district being the richest known in any part of the country.

INDIANAPOLIS TELEPHONE RATES.—The Indianapolis Board of Public Works has denied the petition of the Indianapolis Telephone Company asking for a material modification of the company's franchise. The board, however, was not a unit. Two members said they could not vote to increase the rate for telephones and extend the franchise of the company in the face of public sentiment and the opposition of the press against it. President Elliott said he thought the company was entitled to relief and that public sentiment sometimes overlooked the equity and justness of a petition. He thought it advisable to attempt some sort of compromise. The other members of the committee thought a compromise out of the question and voted to deny the petition. The local press made much of the fact that the company got a franchise upon practically its own terms with the boastful purpose of reducing the cost of telephone service in Indianapolis, in the meanwhile earning good interest, etc. But because it had sold out to outside capitalists no concessions should be granted. The company asked for the right to increase rates from $24 to $32 for residences and from $40 to $54 for business telephones, and an extension of its franchise.

TANTALUM MINERALS.—The United States Geological Survey refers to a recent discovery of a tantalum mineral in a feldspar quarry at Henryton, Carroll County, Md. Near Glastonbury, Conn., an old feldspar quarry is being investigated as to the quantity of columbite or other tantalum mineral that may be found in this feldspar. A mineral from Tinton, S. D., gives on analysis 44 per cent of tantalic oxide and 30.5 per cent of niobic oxide.

QUESTION BOX FOR ELECTRICAL SALESMEN'S CONVENTION.—The general advancement committee of the Electrical Salesmen's Association is planning for the next convention in January a question box on topics of interest to electrical salesmen. All interested are invited to send in questions which they would like to have discussed, to Mr. C. A. S. Howlett, chairman of the general advancement committee, 3300 Beacon Street, Chicago, Ill.

CHICAGO ELECTRICAL SHOW.—The first announcements have been sent out for the second Chicago Electrical Show by the Electrical Trades Exposition Company. A handsome booklet dealing with the last show is issued. The date is set for January 14-26, 1907, at the Chicago Coliseum. The first show was a truly remarkable success both in the number of central station men and in the popular interest attracted. The managing director this year is Mr. Homer E. Niesz, of the Chicago Edison Company.

GAS AND OIL ENGINES.—Mr. James T. Allen, of the United States Patent Office, will soon publish a digest of the United States Patents on oil, gas, air and caloric engines, issued from 1789 to 1905. The work will comprise four volumes, including about 1,000 pages of briefs and claims, 2,000 pages of drawings and 500 pages of indexes, the latter comprising a complete list of the citations by number, name and date, of interferences and decisions. The work will be ready for delivery within a few months, and will be continued by annual supplements.

TECHNICAL STUDY IN INDIANAPOLIS.—The directors of the Technical Institute of Indianapolis are highly gratified over the progress made in its development with the close of the first year. The big buildings on the 76 acres of ground, formerly the United States Arsenal, have been turned into trade school buildings, few alterations being necessary. The power house plant, which heats all the buildings with steam, lights them with electricity and provides all the machinery in all the departments with electric power, attracted unusual attention on commencement week. Adjoining the power plant is the electrical school. Students in this department are already in demand. In his commencement address Mr. Frank A. Vanderlip, of New York, said that the reason that many processes of manufacture and of electrical construction are becoming more difficult and expensive is the lack of skilled workmen.

TELHARMONY IN NEW YORK.—A few months ago we described the beautiful and ingenious system of Dr. Thaddeus Cahill for producing and distributing music electrically by means of his "telharmonium." The apparatus made and tried at Holyoke, Mass., has been removed to New York City and will be assembled again here with the object of making regular demonstrations of the system. A hall has been secured at a central point in the theatre district on upper Broadway, and in the early fall telharmonic concerts will be given for the general public. The plant is being so arranged that the auditors can also be spectators and see the music-making machinery in operation, and the distribution of the music by wire to distant points in the city will also be illustrated.

ELECTRICAL FITTINGS ON NAVY SHIPS.—A dispatch from Washington states that instructions have been sent to the navy yards, including that at Brooklyn, where the battleships are being docked and overhauled preliminary to the summer exercises, to have changes made in the electrical appliances of the turrets. This is the result of the investigation into the accident on the *Kearsarge* some weeks ago at Guantanamo. It was found that the loss of life and the menace to the ship were due to sparks, which ignited powder, and came from the contact of a metal implement with an unprotected electrical fixture. Certain fixtures will be covered with insulating material, which will prevent any such disaster as that on the *Kearsarge*, while other electrical fixtures which can be moved will be transferred from the turrets and placed in another part of the ship.

CANDLE-POWER CONFUSION.—The present unsatisfactory condition with respect to candle-power rating is indicated in the announcement of a lamp manufacturing company that in a new type of lamp which it is placing on the market, candle-power values will not be given on the label. The reason offered for this is that "candle-power is used to express concentrated values due to reflection from supporting frames in such lamps as the Nernst; to express values given by reflectors used with the lamps, as in the case of the Meridian and General Electric units, etc. Candle-powers have as the result of this indefinite use become misleading and confusing, and it has been considered desirable to omit them from the lamp label and to give them only when required, and then fully and accurately defined as 'mean horizontal,' 'mean spherical,' 'values with a given form of reflector,' etc."

A. S. M. E. AFFAIRS.—The well-known headquarters of the Amercian Society of Mechanical Engineers, 12 West Thirty-first Street, New York City, have just been sold for $120,000. The society has thus done very well owing to the rapid advance in the price of real estate in that vicinity. The money will go toward paying for the society's share in the real estate on which the new United Engineering Building stands. Another important event in the affairs of the society is the offering to Mr. Calvin W. Rice the secretaryship of the society, of which he has long been a member. Mr. Rice has had a great deal to do with the new building and was for a time chairman of the Building Fund Committee of the American Institute of Electrical Engineers, so that he is thoroughly familiar with the general situation. His wide acquaintance and his methodical habits of industry would insure great success in the new work.

TELEPHONE COMPETITION IN BOSTON.—The Boston Independent Telephone Company has asked for a franchise to conduct a telephone business in Boston. At present there is an independent company in that city known as the Massachusetts Telephone Company, which is doing business in opposition to the New England Telephone & Telegraph Company, the Bell concern. The Massachusetts Telephone Company, however, does only a small business, having in the neighborhood of about 1,000 telephones. It caters particularly to the wool trade. The new independent company which proposes to enter the field offers rates considerably below those of the Bell Company. The situation in Boston appears to be much the same as it is in New York. The New England Telephone Company is very strongly entrenched in Boston just as the New York Telephone Company and the New York & New Jersey Telephone companies are.

NEW CENSUS WORK.—The President has signed the act of Congress broadening the duties of the Director of the Census. It provides that after the completion and return of the enumeration and of the work upon the schedules relating to the products of agriculture and to manufacturing and mechanical establishments provided for in Section 7 of the act of March 3, 1899, entitled "An act to provide for taking the twelfth and subsequent censuses," the Director of the Census is authorized in addition to other work, every five years to collect statistics relating to street railways, electric light and power, telephone and telegraph business. The Director of the Census shall prepare schedules contaiinng such interrogatories as shall in his judgment be best adapted to elicit the information required under the subjects, with such specifications, divisions and particulars under each head as he shall deem necessary to that end; and all reports prepared under the provisions of this section shall be designated as "Special Reports of the Census Office." For the purpose of securing the statistics required by this section the Director of the Census may appoint special agents when necessary, and such special agents shall receive compensation as hereinafter provided.

Hydro-Electric Plant at Albany, Ga.

BY R. W. HUTCHINSON, JR.

UNTIL comparatively recent years a hydro-electric plant in the far South of any appreciable size was a rarity, especially so when such a plant is located below the "Southern fall line" of Georgia in an almost flat country. The Southern fall line of Georgia is a line connecting approximately Columbus, Macon and Augusta and contains within a radius of 50 miles on either side some of the best water powers in the State. Below this "line" the country becomes undulating and more flat the farther south one goes, so that while the element of abundant water supply in the streams is found to a considerable degree, shoals of any magnitude are relatively scarce. Hence for several reasons—the most salient of which are the undeveloped condition of this section of the State and the comparatively high cost of water power development under the physical conditions above mentioned—very few water power developments have been made in Southern Georgia.

The plant of the Albany Power & Manufacturing Company is, therefore, interesting as being one of the pioneer developments on an extensive scale south of Columbus. The location of this plant is at the Big Shoals on the Muckafoonee River, about one and a half miles north of the City of Albany. Muckafoonee River, which is about one and a quarter miles in length, is formed by the junction of Muckalee Creek and Kinchafoonee Creek, and flows into Flint River a short distance above the city limits. The watershed of these two large creeks covers about 1,025 square miles of slightly undulating country, which contains numerous large springs and brooks of constant flow. The soil of the section drained by these streams is almost entirely of a limestone base, and the water of the streams is largely free from silt or any other organic matter in suspension. At the site of the power plant the banks of the stream are abrupt and precipitous and of limestone formation, so that the conditions for a water power development were quite favorable. From a careful study of the stream measurements for some years the lowest flow in average or ordinary years is estimated to be 650 cu. ft. per second, with an average flow of 1,200 cu. ft. per second.

FIG. 1.—VIEW OF DAM AND POWER HOUSE.

THE DAM.

The dam is 20 ft. in height and rests upon and abuts at both ends upon a limestone formation. It is perfectly straight and is 360 ft. long with a spillway in its center 150 ft. long. The left abutment of the dam is 150 ft. in length, the right abutment 60 ft. in length. The dam is constructed of concrete masonry, and both the upstream and downstream faces are finished in Portland cement concrete. Much difficulty was experienced in the construction of the dam owing to the necessity of transporting the rock for the concrete from a distance, as all the rock obtainable in the neighborhood is of limestone origin and unsuitable for use in the making of concrete. The bulkhead portion of the dam is 23 ft. rising about the crest of the dam. Trash racks, sand gates and the head gates are placed in the upstream side of the bulkhead. Fig. 1 shows the dam and power house. The picture was taken during the flood season when the depth of water over the spillway was about 4 ft. In order to provide for low water 2-ft. flashboards are used on the dam to impound water.

POWER HOUSE.

The power house is situated on the right bank of the stream and its upper end forms a part of the bulkhead of the dam. The building is 30 by 80 ft. and is of fire-proof construction throughout, with walls of brick laid in Portland cement concrete, and floor of concrete finished in cement granolithic. The roof is supported on steel trusses and is covered with tile and gravel. Fig. 2 shows a cross-sectional view of the power house through the rear elevation, and also shows the setting of the turbines and the arrangement of generators in the station. The building is fitted with a 15-ton Niles traveling crane for transporting machinery and materials of construction.

GENERATING EQUIPMENT.

The turbines are four in number and are of the horizontal radial inward-flow type made by the S. Morgan Smith Co. Each unit comprises four wheels 33 in. in diameter mounted in a cast-iron housing 1¼ in. in diameter. The discharge through each pair of turbines passes through a draft tube 7 ft. 9 in. in diameter made of ¼-in. steel plate. The head on the turbines is 23 ft. and each unit is capable of developing 900 hp at full gate. Each unit is direct-connected to its generator through a flange coupling. In addition there is an 18-in. McCormick turbine for driving one of the 45-kw exciters. All of the turbines are controlled by Lombard governors, there being a separate governor for each unit. These governors are fitted with electrical control and can be actuated from the switchboard.

Eventually there will be four generators, all of the same capacity, only two of which are, however, yet in operation. Each machine is a 500-kw General Electric three-phase, revolving-field

type, generating current at 2,300 volts and 60 cycles, at a speed of 180 r.p.m. The armature windings are of the distributed type laid in slots formed in the laminated-field structure. The windings are so designed as to give an inherent regulation of 8 per cent.

The generators are excited by two machines of 45 kw capacity each, one of which is belt-driven from the generator nearest the southerly end of the building. The speed of the belt-driven exciter is 900 r.p.m. The other exciter is chain-driven from the 18-in. turbine and rotates at a speed of 600 r.p.m. The output of each exciter is 125 volts and 36 amp., and either is of sufficient capacity to supply full-load exciting current to all machines. The two will be operated intermittently, however, so that one will always be ready to take up the exciter load.

SWITCHBOARDS AND CONTROL.

The current from the generators is conducted to oil switches located in the switchboard gallery, through paper-insulated, lead-covered cables which are enclosed in vitrified ducts laid in the wall. These cables are of the standard high-voltage pattern. The oil switches have circuit-breaker attachments and the separate terminals are protected from each other by marble slabs.

The switchboard comprises four panels of Tennessee marble, with the usual instruments. The connections on the exciter panel

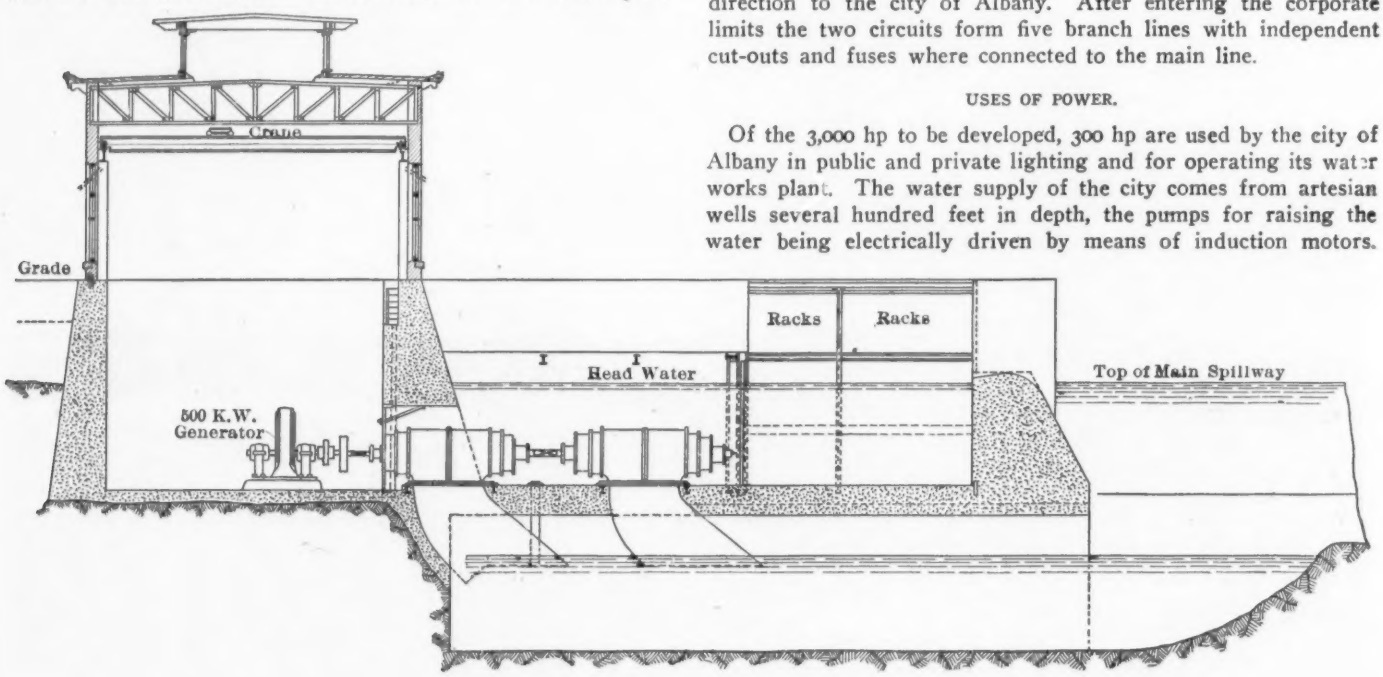


Fig. 2.—Cross-Sectional View of Albany Power Plant.

are so arranged that either exciter may supply current to any or all generators, or the exciter may be operated in parallel and excite the fields of main generators. The feeder panel is equipped with three ammeters, a polyphase watt-hour meter, a power factor meter, a frequency indicator, a synchronism indicator and an operating handle for actuating the automatic circuit-breaker. Each generator panel is provided with a field rheostat, a field-discharge switch and a main oil switch and the usual synchronizing receptacles, in addition to a wattmeter, a voltmeter and an ammeter.

Each outgoing circuit is protected by a "carbon ball" lightning arrester mounted on the wall behind the switchboard. The ground wires of the three arresters are bunched together and conducted to a copper plate buried in charcoal covered over with moist earth.

TRANSMISSION LINES.

There are three independent 2,300-volt transmission lines, two of which run to the city of Albany about one and a half miles distant. The other circuit supplies power to a large phosphate fertilizer works. The three circuits leave the station through porcelain tubes in the wall. The poles used in the transmission lines are red cypress and are 25 ft. in length outside of the city limits and 35 ft. inside the city. The poles average 7 in. across the top and are set 150 ft. apart. The butts of the poles are tarred to a distance of 2 ft. above the ground line. The gains in the poles were coated with white lead before the cross arms were placed in position and the arms coated with red metallic paint.

The cross arms are all of heart yellow pine and are exceptionally large for the conditions of transmission. There are two arms per pole, each of which is 4 in. by 5 in. in diameter, each fastened to its pole through the medium of ⅝-in. bolts and braced by galvanized-iron pieces supported by lag screws. The upper arms are 42 in. long and carry one pin on each side of the pole. The lower arms are 68 in. long and have two pins on each side of the pole. The insulator pins are of locust of the combination wood and iron type with bolt through wood and bolt on top. All pins were treated with paraffin before being put in use. The insulators are of brown porcelain, double-petticoated, Locke pattern; they are 4 in. in diameter across the outer petticoat and guaranteed to withstand a pressure of 6,000 volts.

The circuits consist of stranded aluminum, the cables being of 39,100 circular mils cross-section. The circuits are strung in the form of the familiar triangle, the distance between wires being 16 in. The transmission lines parallel each other for a short distance after leaving the power house, and then branch off, the circuit supplying the phosphate works running in an easterly direction to the point of utilization, which is about three-quarters of a mile distant. The double-circuit line runs in a southerly direction to the city of Albany. After entering the corporate limits the two circuits form five branch lines with independent cut-outs and fuses where connected to the main line.

USES OF POWER.

Of the 3,000 hp to be developed, 300 hp are used by the city of Albany in public and private lighting and for operating its water works plant. The water supply of the city comes from artesian wells several hundred feet in depth, the pumps for raising the water being electrically driven by means of induction motors.

The Albany Power & Manufacturing Company has a 17-year contract with the city of Albany, ratified by the citizens on June 9, 1904, to supply the city with 3,000 maximum hp, the average being 200 hp. The city has its own steam-driven plant, which was shut down in September, 1905, on account of the low price of $27 per hp-year, which the city made with the company. The contract which the company has with the city contains the following provision: "The Albany Power & Manufacturing Company to operate, in the event of its inability to furnish power to the city of Albany from its plant on account of flood, backwater, breakdowns or from any cause whatsoever, the present steam plant of the city of Albany, during such time as it is unable to furnish power from its own plant, paying the expenses of fuel, engineers, firemen and the labor incident to the operation of the said plant."

The largest private customer is the Albany Phosphate Company, which uses 300 hp in operating a fertilizer plant, which has a capacity of 100 tons per day. There are in use in the fertilizer plant one 150-hp, one 75-hp, five 30-hp and two 3-hp motors, all of which are of the three-phase induction type.

Other uses of the power are the operation of the printing plant of the Albany *Daily Herald*, the driving of a grist mill, the running of an ice plant, a ginnery, oil mills, the machinery of one of the largest brickmaking plants in Southern Georgia and the operation of several hotel elevators.

The City Council now has under discussion a municipal street railway system which will likely be constructed and operated with power from the plant of the Albany Power & Manufacturing Company.

OPERATION.

At the present time there are two 500-kw units in continuous operation. The other two units are a reserve to be put in service as the conditions demand. The entire plant was designed by Mr. J. E. Sirrine, of Greenville, S. C., and was constructed by Mr. B. H. Hardaway, of Columbus, Ga., under the supervision of Mr. W. D. Dent. The officers of the company are: Mr. Smith D. Pickett, of Atlanta, president; Mr. Elmer Smith, vice-president; Mr. William Markham, secretary and treasurer. Mr. E. S. Killebrew is superintendent, and to him the author is indebted for much of the information herein concerning the plant.

The Spherical Reduction Factor of Tantalum Lamps.

BY DR. CLAYTON H. SHARP.

On the introduction of a new type of lamp, such for instance as the Nernst or the tantalum, a question should be immediately raised whether the ordinary methods of testing, such as are commonly employed with previously existent types can properly be applied. It is well known, for instance, that the illuminating value of the Nernst lamp cannot be properly estimated from a measurement of its luminous intensity in a horizontal direction, as is done with the incandescent lamp of the ordinary types, but that the more complicated determination of its mean spherical or mean hemispherical candle-power must be made. In the case of the tantalum lamp it is not evident that the mean horizontal candle-power taken in connection with a single determination of the horizontal reduction factor (the ratio of mean spherical to mean horizontal candle-power) is not a sufficiently good criterion of its luminous flux. In other words, it is not clear than the method of photometering which is ordinarily applied to the carbon filament lamp cannot and ought not to be applied to the tantalum lamp. In the case of the carbon filament lamp this method is satisfactory, since it has been thoroughly established that the spherical reduction factor has substantially the same value for all the lamps of a given type. In passing from one type to another, the existent difference between their spherical reduction factors must be taken into account. This is more important than is usually supposed.

If, for instance, a comparison is made of the useful life of carbon filament lamps having a spherical reduction factor of 0.82 with those having a factor of 0.80, operating them so as to give the same mean horizontal candle-power with the same watts, it will be found that the life of the lamps with the lower reduction factor is approximately 10 per cent longer, provided they are equally well made lamps. This is easily explained. The lamp with the smaller reduction factor gives less total flux of light when yielding the same horizontal candle-power than does the other type. Hence its watts per mean spherical candle-power are higher, and it is operating actually at a lower efficiency, and the lower the efficiency the longer the life. If operated at the same mean spherical efficiency as the other lamp it would give a higher horizontal candle-power, but at the same time a candle-power in other directions enough lower to counterbalance it, the total light emitted being the same, and the life being the same.

An inspection of the tantalum lamp would lead one to suppose that its spherical reduction factor would be substantially as unvarying as is that of a given type of carbon filament lamp. Moreover, since the theory indicates that the spherical reduction factor of a filament consisting in a straight, black, non-lustrous rod must be 0.785, the factor for the tantalum lamp should be lower rather than higher than this, its surface being metallic, smooth and bright when the lamp is new. As far as the writer knows, all tests of tantalum lamps which have been published are based on horizontal candle-power values, no attention being given to the fact that this procedure, while allowable with carbon filament lamps, may not be valid with the new lamps. As has been said, there is nothing to indicate that this is not the case. Values of the spherical reduction factor have been published in at least one instance, 'Kennelly and Whiting: ELECTRICAL WORLD AND ENGINEER, March 25, 1905, these values being smaller than 0.785 and varying considerably among themselves.

In the course of tests of a considerable number of these lamps it was found that the spherical reduction factor of tantalum lamps is by no means constant, but varies considerably from lamp to lamp. This variation is so large that a typical value for the reduction factor of these lamps cannot be established. It follows, therefore, that the value of the mean spherical candle-power of a tantalum lamp cannot be accurately obtained from a measured mean horizontal candle-power multiplied by a typical reduction factor, as is done in the case of the carbon filament lamp, but the mean spherical candle-power must in every case be measured.

Moreover it was discovered in the course of a life test of

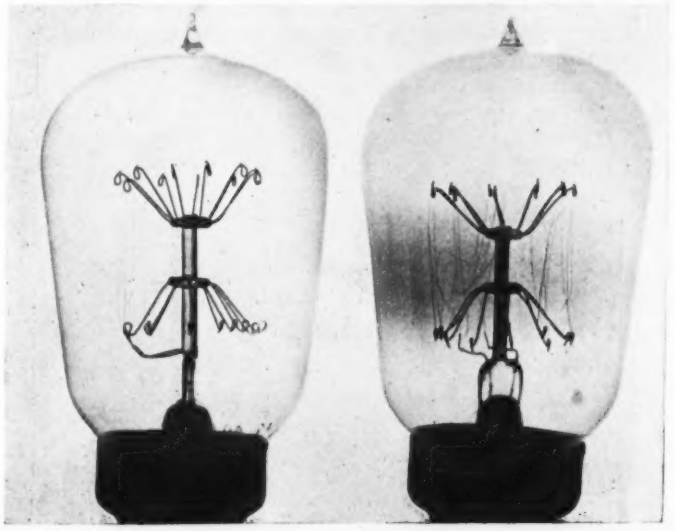


FIG. I.—TANTALUM LAMPS.

these lamps that the spherical reduction factor attains a larger and larger value as the lamp ages. Data on this point are contained in the following table:

SPHERICAL REDUCTION FACTOR OF TANTALUM LAMPS.

New.	Old.	Change.
0.764	0.856	12%
.715	.878	23
.760	.886	16.5
.738	.938	27
.726	.888	22
.688	.864	25.5
.716	.909	27
.742	.924	24.5
.707	.902	27.5
.711	.925	30
Mean 0.726	0.897	23.5

It will be seen that the variation with age is a very large one, amounting in one case to as much as 30 per cent of the initial value. This indicates that a smaller and smaller proportion of the total light of these lamps is emitted in the horizontal plane and, operating unfavorably to the lamp if the test is made on a horizontal candle-power basis, is of great importance in testing. The decrease of candle-power with age, as shown from horizontal readings alone, is exaggerated. In fact, it was found that in making measurements of mean spherical candle-power instead of mean horizontal, the light yielded by several of the lamps was actually greater near the end of their life than it was initially. It should be stated, however, in this connection that the candle-power usually rises very rapidly at first, and that the intensity of the old lamp is always lower than the maximum intensity which the lamp yields. This effect is increased by short circuits occurring between adjacent spires of the filament which cause the remainder of the filament to glow with an increased intensity. In any case, the conclusion is strongly emphasized that tests of tantalum lamps, if they are to represent the facts, must be made on a basis of mean spherical candle-power readings.

Evidently this change in spherical reduction factor must be accompanied by a change in the distribution of the intensity of the light in a vertical plane. That this is the fact is illustrated by the two curves of the accompanying figure, which show the distribution for a new lamp and for an old one.

It is interesting in the next place to inquire the explanation of this peculiarity. One reason is obvious from an inspection of an old lamp. The bulbs of the tantalum lamps become blackened with age just as the bulbs of carbon filament lamps do. There is, however, this difference, that whereas the black deposit on the bulb of a carbon filament lamp is distributed in a fairly uniform manner on the whole interior of the bulb, the deposit on the tantalum bulb is much denser in a horizontal zone of a width substantially equal to the length of the spires of filament stretched between their supports. In other words, the deposit is most copious in those parts of the glass which are parallel to the spires of filament and nearest to them. This effect is clearly shown in the accompanying illustration.

The effect of this zonular deposit is to decrease the horizontal intensity of the light in much greater degree than the intensity in the other directions, and so to effect a redistribution of the luminous intensity in the proper sense to make the spherical reduction factor larger than before.

Another reason can be found in the changes which the surface of the filament undergoes with use. The filament of a new

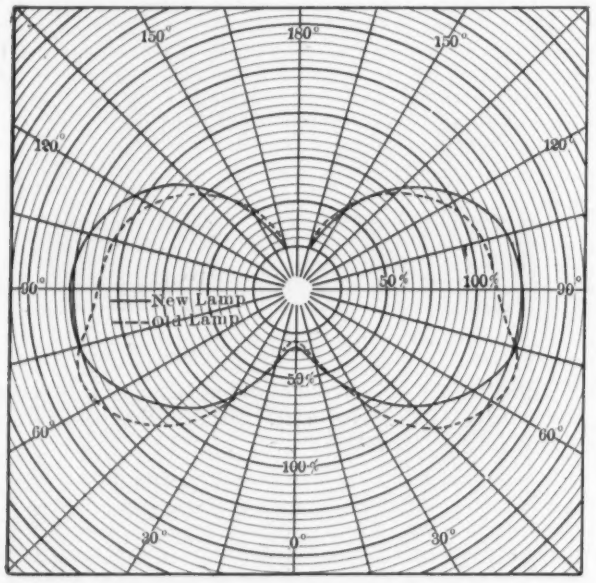


FIG. 2.—VERTICAL DISTRIBUTION OF CANDLE-POWER OF NEW AND OLD TANTALUM LAMP.

lamp looks under the microscope like a polished steel wire with a surface entirely smooth except for slight pittings here and there. As has been indicated above, the spherical reduction factor of a straight filament must be theoretically less than 0.785. The better the reflecting power of the surface of the filament, the lower will be the factor. In accordance with this law it is found that the spherical reduction factor for the new tantalum filament varies about an average value of approximately 0.73.

It has been found, however, that the nature of the surface of the filament changes radically with age. The smoothness disappears and the outside becomes scarred and pitted and broken. This change must result in a relative increase in the radiation in directions not at right angles to the filament and hence in a larger spherical reduction factor. These two changes, the localized blackening of the bulb and the roughening of the filament, taken together account for the large increase in the spherical reduction factor. Of these two causes, the blackening is of much the greater importance. It would be of practical interest to ascertain the effect of enclosing the tantalum filament in much larger bulbs, perhaps spherical in form. If the distance between the filament and the glass is greater than the mean free path of the tantalum particles expelled, the blackening might be decreased or uniformly distributed over the surface, either of which would result in an improved efficiency of the lamp.

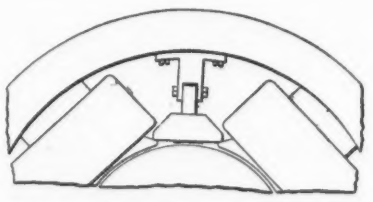
The procedure in photometering tantalum lamps differ in another particular from that practised in dealing with carbon filament lamps. It is the usual practice in this country to determine the mean horizontal candle-power of the carbon lamp by rotating the lamp on the photometer at a rate of about 180 revolutions per minute. The statement has been made that on account of the zig-zag shape of the filament of the tantalum lamp its intensity is the same in all directions in the horizontal plane. If this were the case the mean horizontal candle-power could be determined by measuring the candle-power of the lamp in any horizontal direction. It is found, however, that this is by no means true. The horizontal distribution curve of this lamp, far from being a smooth circle, is rather after the nature of a circle with a great many long saw teeth running from it. That is to say, the lamp gives a great many bright streaks of light in the horizontal direction just the same as the carbon filament lamp does, only that there are many more of them with the tantalum filament lamp.

It follows from this that the mean horizontal candle-power must be determined by some method which will yield an integrated value on the photometer disc. The natural procedure is to treat this lamp exactly as the carbon filament lamp is treated, placing it in a rotator running at 180 revolutions per minute and photometering it. It is found, however, that when this is done the action of the centrifugal force on the vertical spires of the filament is sufficient to cause them to bow outward perceptibly. This results in a change in the vertical distribution curve of the lamp, the candle-power in the direction of the tip being strengthened at the expense of the horizontal candle-power. It will be seen, therefore, that this also works to the disadvantage of the lamp if the horizontal candle-power is taken as the criterion. The filaments which have been bowed by too rapid rotating will come back to their normal form if allowed to burn for a while stationary.

One way to obviate this difficulty is to reduce the speed to 40 revolutions per minute when this effect is no longer apparent. Another way to obviate the difficulty is to make measurements on some form of spherical integrating photometer. The Matthews photometer may, with advantage, be used for this purpose. Evidently the indications of this instrument are independent of the form of the filament. At the same time it is deemed better practice to reduce the speed of the rotator to the lowest practicable limit even when the integrating photometer is used, as this reduces greatly the mechanical stresses which otherwise might endanger the lamp.

Commutating Pole for Direct-Current Motor.

A patent issued May 22 to Mr. F. Sieber and assigned to the Westinghouse Electric & Manufacturing Company, discloses a method for economically winding the commutating poles on variable-speed, direct-current motors. The construction em-



COMMUTATING POLE AND WINDING.

ployed is shown in the accompanying illustration. It consists in concentrating the convolutions of the coils of the auxiliary winding as near the armature as possible, so that the winding may serve both as an effective compensating winding for the field produced by the ampere-turns of the armature and as an exciting winding for the commutating poles.

The patent contains six claims, one of which reads as follows: In a dynamo-electric machine, the combination with an armature, of a field-magnet frame provided with main polar projections and with auxiliary polar projections of smaller cross-section that are located between the main polar projections and are provided with coils that are concentrated in close proximity to the armature.

The Testing of Incandescent Electric Lamps.

BY PRESTON S. MILLAR.

BECAUSE of its delicate nature and susceptibility to variations in conditions the performance of the incandescent electric lamp is in many instances erratic. This, combined with the fact that even the best manufacturer's product includes a certain percentage of poor lamps which, when they are new, cannot be distinguished from the good lamps, has led to a recognition of the need of purchasing lamps subject to tests. The conditions are such that this need is recognized in the case of incandescent electric lamps more readily and more universally than in the case of any other electrical supplies. The result is that all over the country purchasers are applying tests in an endeavor to determine which manufacturer produces lamps of the highest candle-hour value. All along the line, from central stations to department stores, one may find such tests being made. This is commendable in that it tends to the advancement of the art of lamp manufacture, since each manufacturer strives to improve his product and to submit to such test the best lamps he has at his disposal. One might be excused for thinking that in this respect conditions are as they should be, were it not for the great inconsistencies shown in the results obtained. There is hardly a lamp maker of importance in the country who cannot point to some tests made by independent parties which have resulted in showing his product to be better than all other products submitted to the test. Every lamp has its adherents who sing its praises with the greatest enthusiasm and will not listen to claims of superiority for any other lamp. It is a fact that there is a variation of as much as 50 per cent between the average products of different manufacturers, and yet the manufacturers of poor lamps have repeatedly been awarded contracts based upon tests in which good lamps were represented.

As instances of the fallacious conclusions which may be arrived at as the result of lamp tests as sometimes conducted, the following are cited:

A representative of a certain State institution stated that he had made an exhaustive study of various prominent makes of lamps. As the result of a number of years testing he had concluded that *X* lamps were not worthy of consideration, and he did not propose to include them in such tests as he might make in the future. On the other hand he had found the *Y* lamp to be generally of high quality and had, during the past year, placed a contract with the maker of this lamp. The facts of the case were that the *X* and *Y* lamps were made in the same lamp factory by precisely the same process and operators, but received different labels before being issued.

A certain central station whose annual lamp purchases numbered many thousands decided to conduct a lamp test in order to determine whether or not they were purchasing the best lamps available. The matter was placed in charge of one of the engineers of the company who had the valuable assistance of a certain lamp salesman in conducting the test. The result was that the contract for the following year was placed at a higher price with a manufacturer of lamps which were so designed as to take advantage of the present fallacious method of rating, but possessed no higher value than the lamps which had previously been purchased. Incidentally, the lamp salesman who assisted in the conduct of the test was in the employ of the manufacturer to whom the contract was awarded.

These instances serve to illustrate the uncertain nature of the results which are secured as the result of lamp tests conducted by private parties. It is the purpose of this article to inquire into the causes of such inconsistencies, to point out some of the difficulties which must be met and overcome if lamp tests are to prove valuable, and to indicate conditions which should be aimed at as ideal when such tests are to be made.

In laying out plans for tests upon lamps three points must be borne in mind:

1. The candle-hour value of every lamp manufacturer's product varies from time to time.

2. Every manufacturer makes both good and poor lamps.

3. The average product of some manufacturers is better than the average product of other manufacturers.

With these axiomatic statements before us it is apparent at once that basing sweeping conclusions as to the merits of various makes of lamps upon the results of a test upon one group of each make is unwarrantable. It is also patent that each make must be represented by a sufficient number of lamps to afford a representative value. Each group must be large enough to prevent the performance of erratic individuals from exercising undue influence upon the average.

One may frequently hear manufacturers of lamps complain because conclusions are based upon tests of ten lamps only, yet they invite such comparisons by instructing their salesmen that "No more than six lamps shall be furnished as samples to any consumer without full, regular charge." The writer has known of contracts which have been based upon the results of test of three lamps of each of a number of makes.

It is equally important that care be exercised in establishing proper conditions for the tests. Different types of lamps are rated in different manners; some by mean horizontal candle-power, others by maximum horizontal candle-power, others by end-on candle-power. A rather complete photometric equipment is necessary to determine the mean spherical candle-power of lamps of these various types. Those not possessing such equipment are prone to accept manufacturers' directions as to the manner in which the lamps should be measured or to ignore entirely the photometric differences between lamps of various types. This sometimes results in establishing unfair conditions which tend to vitiate a comparison between different types of lamps.

Again, lamps of different voltages are sometimes placed upon test. These differences necessitate separate circuits, controlled individually by rheostats. This results in the introduction of possibilities of error in the establishment and maintenance of the voltage on separate circuits—always a difficult matter because of the varying pressure which is likely to prevail.

Failure to provide lamps of substantially the same efficiency likewise results in difficulty in drawing proper conclusions from the tests. The only safe criterion by which to judge the relative efficiency of lamps is the specific consumption or the watts per mean spherical candle-power. When lamps of only one type are to be tested, the watts per mean horizontal candle-power or the watts per candle-power in a particular direction may serve as a basis of comparison, but when lamps of different types are to be tested the comparison must be based upon considerations of mean spherical candle-power and watts per mean spherical candle-power.

The best practice is to procure the test lamps directly from the manufacturer, stating frankly that they are to be used for test purposes. This suggestion usually meets with the objection that the plan affords the manufacturer an opportunity to submit lamps which are better than his average product. So strongly does this impression prevail that instances are known where an engineer has received samples from manufacturers for purposes of test and has exchanged such samples at supply houses for other lamps of the same manufacture, placing the latter upon test, and permitting them to suffer or profit because of too high or too low voltage rating, as the case may be. The facts are that the manufacturer is unable to select lamps which will be better than his average product with the sole exception of his ability to eliminate lamps which are obviously faulty. As such lamps should not be placed on test in any event, their elimination from a test group becomes desirable. The object should be to secure lamps which are as closely rated as possible, in order that the test may serve to demonstrate the value of the lamps independently of their rating. Those purposing to conduct a lamp test should be glad, therefore, to avail themselves of every opportunity to permit the manufacturer to deliver to them closely rated lamps, representative of his best quality. The lamps delivered under the contract awarded after the completion of the test should then be inspected at the factory before shipment and should be expected to be closely rated and free from obvious faults. Unless the lamps shipped under the contract are so inspected, the competitive test is of little avail, since the poorly rated product of the best maker of lamps is not so desirable as the well-rated product of a manufacturer who is not capable of making first-class lamps.

Instances are known where, because of insufficient equipment,

the test has been divided, the sample lamps of some manufacturers being tested first, while the samples of other manufacturers were submitted to a supplementary test after the completion of the first test. This practice cannot be too strongly condemned. If the results are to be comparable all the lamps must be operated throughout the entire test under exactly the same conditions. There are probably not over three laboratories in the country where conditions are sufficiently constant to insure the validity of comparisons made under other conditions.

In order to guard against sources of difficulty which enter into the situation the following precautions should be observed:

Not fewer than twenty lamps of each make should be included in the test.

The lamps should be as closely rated as possible.

At a given voltage the average candle-power and watts of each group should be substantially the same.

Where more than one type of filament is tested, as for example the oval, elliptical coil and spiral filament, all candle-power measurements should be in terms of mean spherical candle-power.

The lamps should all be burned upon the same line without any variable resistance.

The entire test should be stopped whenever the lamps are to be photometered, so that all the lamps shall have burned all the way through their lives under exactly similar pressure conditions, even though those pressure conditions be wrong.

The average mean horizontal candle-power values, or if more than one type of filament is included, the average mean spherical candle-hour values of the sample groups tested should be taken into consideration in awarding the contract.

A single test, however, should not be regarded as conclusive since any one or more of the groups tested may not have been representative of the average product of the manufacturer. Samples of the lamps shipped under the contract should be tested from time to time in connection with samples of some other maker's product, which there may be reason to believe represents a high standard of quality. In these tests the same precautions noted above should be observed.

Lamp tests, to be of greatest value, should attain the following objects: First, they should determine the relative values of different makes and types of lamps; second, they should secure good selection and accurate rating for lamps supplied under contract; third, they should assure fulfillment of guarantee as to life and candle-power maintenance.

As has been pointed out, the first of these objects may be attained by exercising care in securing comparable conditions for a life test upon lamps. The second object can best be accomplished by tests and inspections applied at the factory of the manufacturer before the lamps are shipped. The third object can be secured only by an equipment especially provided and designed to afford conditions which are as nearly as possible perfect.

In connection with the foregoing, a brief description of an actual equipment for lamp testing and which meets the above requirements may not be out of place. In the tests made with this equipment the lamps, as a rule, are operated upon a 60-cycle circuit. When desired they may be tested at any commercial frequency or upon direct current. Any voltage from 1 to 300 is available. Six thousand sockets are provided, giving ample facilities for tests at any required voltage. In most cases the lamps are tested at voltages at which they give either their rated candle-power or some candle-power which will secure a higher efficiency for the purpose of a forced test. In either case it becomes necessary to determine the test voltage with precision. Twelve photometers of seven different types are provided. These include integrating photometers for determination of mean spherical candle-power. The standard of candle-power, which plays so important a part in the determination of candle-hour values, consists of copies of authentic master standards. These have been compared directly or indirectly with the standards of the National Bureau of Standards, at Washington, the Physikalisch-technische Reichsanstalt, of Germany; the Laboratoire Central D'Électricité, of France, and the National Physical Laboratory, of England. The equipment also includes Hefner and pentane lamps as primary standards. The stock of secondary standard lamps numbers about 800.

The electrical instruments used in photometry are either a potentiometer used with the standard cell and a standard resistance for the determination of volts and amperes, or laboratory standard voltmeters and millivoltmeters standardized by the potentiometer.

The lamps are adjusted on the life-test racks to a voltage which is within about 1/10 of 1 per cent of that desired. This voltage is measured in an adjoining room by instruments of precision, standardized by the potentiometer and standard cell. Automatic regulators, supplemented by hand control, secure very close voltage regulation, average variations not exceeding ¼ of 1 per cent. At frequent intervals the lamps are removed from the life-test racks for measurements of candle-power and watts. Particular precautions are taken to determine with accuracy the expiration of the useful life period. Useful candle-hours are computed by polar planimeters from curves plotted upon cross-section paper. Results are presented in illustrated reports in terms of either mean horizontal or mean spherical candle-power hours, as the conditions may require.

The facilities and methods are such as to permit of accurate forced tests; that is, tests at consumptions higher than normal. These serve every purpose since it becomes possible to determine correctly ratios for the interpretation of the results of forced tests into terms of tests made at normal consumption. As a result tests which will secure information on a sufficiently large number of lamps to insure representative values may be made which, under less accurate conditions would restrict the lamps tested to a number too small to secure representative results.

Electrical Engineering Laboratories at Worcester Polytechnic Institute.

Some weeks ago we referred to the new laboratories for the Electrical Engineering Department of the Worcester Polytechnic Institute, and are now able to present a general description of the building and some of the more important features of the equipment. The laboratories have been planned by the members of the Electrical Engineering Department of the Institute with Messrs. Peabody & Stearns of Boston serving as architects, and Professor A. W. French, of the Civil Engineering Department of the Institute, as consulting engineer and superintendent of construction. A contract for the building has recently been placed with the Central Building Co., of Worcester, at a cost approximating $125,000, exclusive of equipments, and it is expected that it will be ready for the accommodation of students early next year.

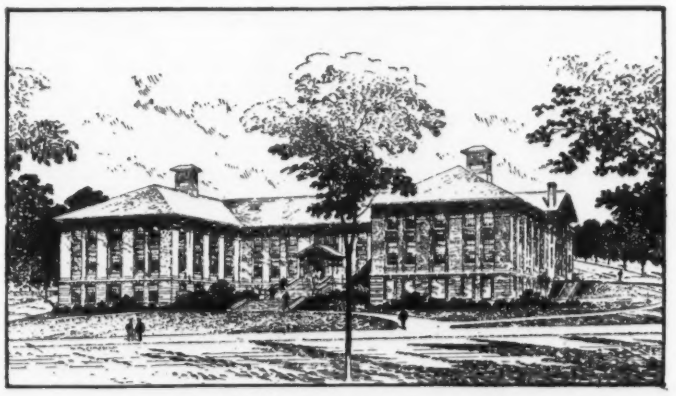


FIG. I.—ELECTRICAL ENGINEERING LABORATORIES.

The perspective elevation gives a good idea of the general appearance of the building, which will be constructed of a selected red brick with darker red brick and brownstone trimmings and a roof of light green slate. The building will be located 75 ft. from the street at the northerly end of the Campus, and facing to the north upon Institute Park from which the perspective view is taken.

On the lower, or basement floor plan, there are shown in the easterly wing, three recitation rooms and two offices. These rooms are so placed as to be readily available either for recitation or lecture work before small sections, or for use as

special laboratories as the growth and future demands of the department may require. It is proposed to use one of these rooms as a telephone laboratory at an early date, and a second room may be occupied by magnetic testing apparatus. Under the east end of the general laboratory is space for a storage-battery room and storage for heavier apparatus, which may be deposited on this floor by an electric crane traveling over the general laboratory above. An entrance and vestibule at the east end of the building gives ready access to this part of the building. Ample accommodation for toilet, locker rooms and heating equipment are shown at the center of the building and under the main entrance vestibule and stairway. In the westerly wing, at the right and under the lecture hall, is located the standards lab-

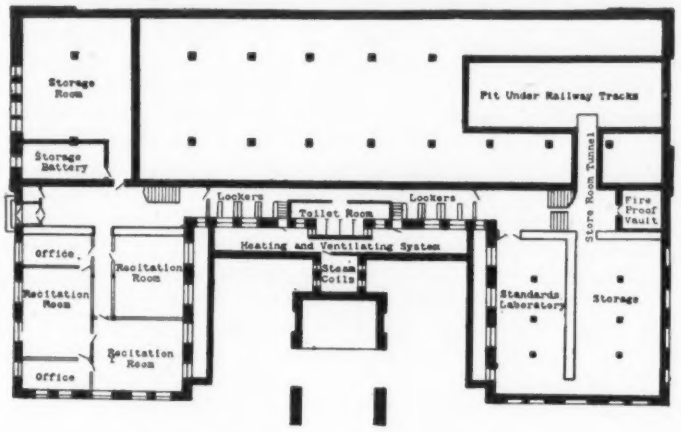


FIG. 2.—BASEMENT PLAN.

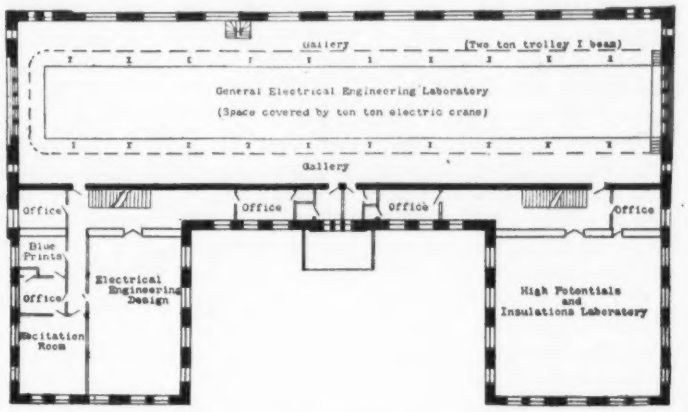


FIG. 4.—SECOND FLOOR PLAN.

oratory, where standard reference instruments and apparatus will be found and where the more exact work of calibration and standardization will be conducted. At the extreme westerly end and under the lower portion of the lecture hall will be located a large storage room where heavy pieces may be lowered by an electric crane. A portion of this storage space

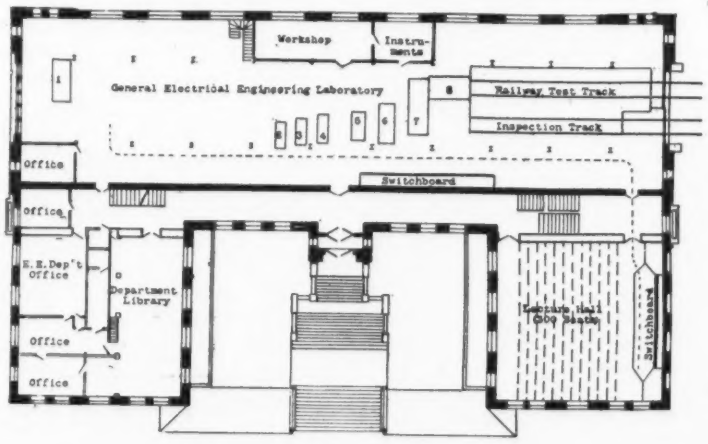


FIG. 3.—FIRST FLOOR PLAN.

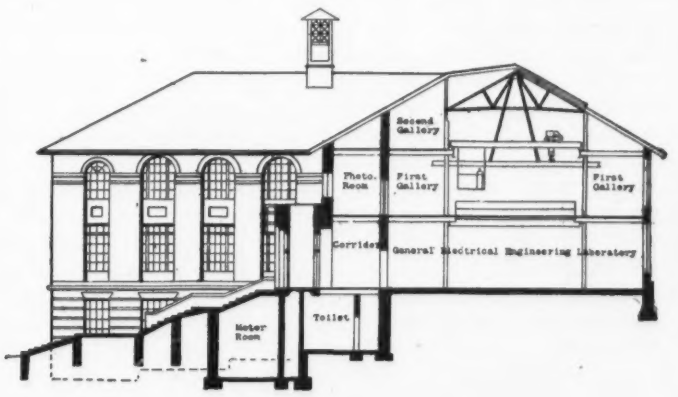


FIG. 5.—TRANSVERSE SECTION.

may be used for a photometic laboratory. Under the western vestibule is located a fireproof vault for the storage of records, lecture notes and manuscript, experimental data and the more valuable and delicate instruments of the department. A pit for the two railway tracks entering the general laboratory above is shown in the basement plan.

Referring to the first floor plan, there are three features of primary importance. First, is a large general laboratory, having a length of 200 ft. and width of 55 ft., containing, with the three galleries shown in the transverse section, a floor area of 19,400 sq. ft. and volume of about 400,000 cu. ft. (the entire building containing nearly 1,000,000 cu. ft.) thus constituting what is undoubtedly the largest electrical engineering laboratory in the world. This laboratory is served by a 10-ton electric traveling crane covering the entire central portion of the laboratory between the galleries. On this main floor space under the crane will be located all the heavier pieces of equipment.

Reference to this transverse section through the center of the building gives an idea of the location of galleries and traveling crane. The galleries are designed to accommodate the lighter and accessory laboratory equipment such as the switch-signal, air-brake and controller apparatus for electrical railway work, the arc-lighting apparatus, transformer and all other equipments not having heavy rotating or reciprocating parts. The galleries are served by 2-ton trolley hoists covering their entire length. The large volume of the room ensures ventilation, and ample lighting is secured by the immense windows at each end of the laboratory, one of which is seen at the end of the building in the perspective, and large windows the entire length of one side.

Opposite to the main entrance to the general laboratory will be found the workshop and instrument room under the south gallery and so located as to be reached conveniently from all portions of the laboratory. The workshop will be equipped with motor and machine tools necessary for ordinary maintenance and repair of equipment, and the building of such special equipment for the laboratories as can be undertaken advantageously. The instrument room will contain the general supply of portable instruments for common use in the laboratories. On the main floor are indicated a few of the larger features of the equipment: No. 1 is a hatchway permitting the crane to lower apparatus to the storage room below. No. 2 is an 18-kw, 110-volt, direct-current compound dynamo directly connected to a 30-hp induction motor. No. 3 is a 30-kw, 110-volt, direct-current compound dynamo directly connected to a 50-hp induction motor. No. 4 is a single-phase, 220-volt, 60-cycle alternator directly connected to a 30-hp induction motor. No. 5 is a 50-kw, 500-volt, direct-current compound dynamo directly connected to a 100-hp induction motor. No. 6 consists of two 60-kw, single, two or three-phase, 60-cycle alternators directly connected. No. 7 is a 300-hp, motor-driven, 200-kw, double-current generator delivering 25-cycle, alternating-currents, either single or two-phase, from one end and 500-volt, direct-current from the other end. No. 8 is the foundation for a traction

dynamometer at the end of the railway test track. This test track will be very completely equipped for the study of car, motor, brake and controller operation. On this test track may be placed any foreign car up to 60 ft. in length, or the Worcester Polytechnic test car may be used upon this track for all purposes of instruction in this class of electric railway equipment and operation. The Institute test car will be fully equipped for all classes of track and run tests and may be run upon any lines.

The above generators and motors are all controlled from the switchboard at the right of the main entrance to the laboratory. This board will be of black slate, 7 ft. high and 40 ft. in length. On the board are panels for each of the above motor-driven generators and the experimental and the general supply and distribution circuits for the building.

The large collection of smaller pieces of equipment will be located at the eastern end of the general laboratory and in the galleries. The supply of current is received from the Power Laboratory of the Institute, where about 500 kw, in two-phase, 60-cycle currents will be available upon completion of developments which are now taking place and which will be finished prior to the completion of the Electrical Engineering Building. The wall separating the general laboratory from the main corridor and the two wings of the building is a fire wall throughout and all openings through it are protected by automatic metal fire doors.

In the west wing of the building is located the second principal feature, namely the lecture hall, which is capable of comfortably seating 300 persons. There is a difference in level of 8 ft. from front to back of the room, so that a good view of the demonstration table is obtainable from every seat. Because of the arrangement of the hallway and outside entrance and vestibule at the west end of the building, the lecture hall has two entrances, both of which are at the level of the lecture hall floor, although one is at the back and the other at the front of the room. Back of the demonstration table is a switchboard controlling-circuits reaching any equipment of the department, and the power units of the Power Laboratory. An overhead trolley hoist will take equipment from the crane in the general laboratory to the demonstration table. Facilities for darkening the room and for the projection of lantern slides will be provided.

In the east wing is located the third principal feature, namely the department library and reading room, which will be attractively and conveniently fitted for its purpose. On shelving extending the entire length of the side next to the offices and upon the other wall spaces of the room, will be room for 3,000 volumes. Reading and study tables will occupy the center of the room, and periodical cases the space between the windows in the west side of the room. The room is conveniently located for use in connection with the recitation and electrical engineering design rooms immediately above, the general laboratory opposite, or the several laboratories in other parts of the building. Most of the department offices are located upon the first floor and along the east end of the building.

Upon the second or upper floor of the building—actually the third floor of the two wings—in the west wing is a large high-potentials and insulations laboratory where are located the high-potential transformers, permitting the use of voltages of any desired frequency and potential up to 750,000 volts for the study of the various problems of long-distance, high-potential power transmission and the dielectric and electrostatic phenomena of insulating and other material. It is proposed to develop this laboratory work on a most comprehensive scale, the Institute being a pioneer among the colleges in the study of very high-potential phenomena as well as a pioneer in the establishment of a chair of electric railway engineering, and in the provision of extensive facilities for both of the above lines of work.

In the east wing is located the electrical engineering design room where instruction will be given in the actual design of electrical apparatus and systems. In this work the Institute stands among the first few engineering colleges of the country to establish a distinct course under men experienced in the actual commercial design of electrical engineering equipment.

Upon the completion of the building and installation of its equipment, the Institute may congratulate itself upon possessing the largest and most complete electrical engineering laboratories to be found in any college in the world.

The Electric Tramway and Electric Omnibus in England.

By W. V. Picton.

WHEN the locomotive was introduced in England some 70 years ago, the gradual disappearance, if not the total extinction of the horse was freely predicted. It was thought that steam would supplant animal power. Similarly, when electric light first came to be used instead of gas a fall in gas stocks was predicted, and those who had interests in undertakings of this character were fain to sell their stocks and seek other lodgment for their savings. Both the above prophesies have been utterly falsified. In the case of horses, at the present time there are more horses owned and used by English railway companies than there were horses in England when George Stephenson ran the "Rocket" for the first time; in the case of gas companies the sale of by-products is often so profitable that some companies aver that they might give away every cubic foot of gas which they produce, and yet make a profit!

Mention is made of these prophesies and of their falsification for the purpose of drawing attention to the present condition and prospects of electric traction in England. Having regard to the fact that many American engineers are closely interested in the development and prosperity of electric traction in England, it is anticipated that a short presentation of this question may not be out of place in the columns of an American technical journal.

The last decade has witnessed an enormous increase in the use of electricity as a motive power. Though slow at first to adopt this means of locomotion, the British public, represented by the private company or the municipal body, suddenly woke up to the fact that no city or decent-sized country town should be without its system of electric tramways, and that wherever possible the old and steady going horse tram should be abolished. It was anticipated that town might be connected with town by this means, and that, even though the traffic returns might at first be somewhat poor in a thinly populated district, the advent of the electric tram would promote the building of houses all along the route, and a corresponding increase in traffic. These anticipations have been fully realized. It is now possible to travel from Leeds to Manchester—a distance of some 40 miles—by tram. This may seem a trifling distance to those who are accustomed to the broad acres of the United States, but to the Britisher the establishment of a mere tramway 40 miles in length is a matter of no small importance.

It may be mentioned that in England the right to run tramways in streets is conferred by Act of Parliament. It is what is known as a "franchise" in the United States. So profitable, so important to the public have electric tramways in England proved to be that these undertakings are now for the most part in the hands of local authorities, and with respect to those which are not already in municipal hands, provision has been made in each Act of Parliament to enable the local authorities to buy them up, after the expiration of a certain number of years at "old iron" prices. The prosperity of electric tramways has been such that until very recent times they have been regarded as the universal panacea for every trouble which besets the municipal path. On the one hand the profits made go in relief of the taxes; on the other, the provision of an easy and swift means of locomotion for the working man goes far towards the solution of the overcrowding problem. By some it is claimed, however, that municipalities have gone beyond the bounds of prudence in this direction, and that "municipal" trading in electrical utilities have placed a burden on the tax payer which in time will lead to catastrophe.

While dealing with the question of electric traction, mention should be made of the adoption in England of electricity as a motive power on railways. Several of the older railways—notably the North Eastern in Northumberland, and the Metropolitan in London—are running electric trains on their old rails, while it is well known that subterranean London is now in a fair way to be honeycombed with tubes along which trains are run which could not have been thought of before electricity was introduced.

Enough has been said to show that, if use may be made of a

hackneyed phrase, electricity as a means of traction has "come to stay" in Great Britain. It has supplied a want; and although in the matter of suburban traffic electric tramways have proved to be serious competitors to the older railways, the railways continue to flourish. This, it may be noticed in passing, is a further illustration of the principle which the writer attempted to illustrate in the commencement of this article.

Why, it will be asked, was it necessary to refer to or to illustrate that principle? The answer is not far to seek. It is that the competitor of the electric tramcar and the electric railway is already on the road, and that the pessimistic prophet is already at work. It is said that the motor omnibus will work the undoing of electric tramway enterprise. Many of these vehicles are to be seen daily in the streets of London. They carry large numbers of passengers, are supplanting the horse omnibuses almost entirely, and have sprung rapidly into popular favor. It is said that a motor omnibus, which can carry 34 passengers, is able to earn $60 a day (running 120 miles in the day). Further, given a life of five years, each omnibus will not only be able to pay a dividend and the cost of repairs and upkeep, but will be able to earn, in addition, the price of a new vehicle which can replace the old one at the end of that period. This is, however, a matter for speculation, inasmuch as the life of these vehicles has not yet been put to the test.

The prophets, to which allusion has already been made, are asserting that the motor vehicle will supplant the electric tramway. It is obvious that the proprietors of the new vehicle have many advantages. In the first place they need not incur the expense of obtaining parliamentary powers and they have no track to maintain; secondly, their vehicle can run on any route, and that route may be varied according to the requirements of the traffic; thirdly, in its course along a street the bus is not confined to one narrow strip, but may thread its way through the traffic. Finally, experience in South London has shown that they may be the successful competitors of electric trams along the very route of these vehicles. In the result there is a distinct tendency on the part of the public to invest their money in motor omnibus companies, notwithstanding another tendency to apply the fearful term "electrobus" to the vehicle exploited.

Having raised up the dummy it is now necessary to see whether it cannot be demolished. Just as prophecy was falsified in the case of steam versus horse power, so it is anticipated that the forebodings of those who bear the competition of motor omnibuses with electric tram cars will prove to be without foundation. So far from competing, it may be found hereafter that motor omnibus and tramcar will each assist the other. The latter will tempt people to go far from their homes; the former will make them go still further afield.

Besides this it has to be remembered that each new means of locomotion which is discovered to some extent creates its own traffic. The fact that there are omnibuses provided along a particular route will tempt people to travel by that route, and it will not, therefore, be necessary for those who provide these vehicles to run them in direct competition with electric trams.

Composite Incandescent Lamps.

A patent recently granted to Mr. H. C. Parker describes a form of incandescent electric lamp in which the current path is composed chiefly of refractory non-conducting substance, but with a small percentage of conductive substance mixed therewith. Thorium oxid or carborundum is mixed with a small portion of graphite, the whole mass being compressed into a pencil. The current, which may be passed through the pencil when it is cold, raises its temperature to a value to cause it to become an effective illuminant. To form the pencil three or four parts of the oxid are mixed with one part of graphite and reduced to a fine powder. The parts are then held together by a suitable binder forming a sort of dough which can be forced through a die to make the pencil of the right size and the pencil can be cut into the requisite lengths and dried and baked. It is stated that the pencil is of such a nature that it will not flame, but will glow with a bright incandescence when sealed within a tube from which the air is partially exhausted.

The Proceedings of the National Electric Light Association.

A SPECIAL supplement of the ELECTRICAL WORLD of 24 pages was devoted last week to the proceedings of the twenty-ninth annual meeting of the National Electric Light Association at Atlantic City. As the meeting was prolonged until Friday evening the report was not closed when that issue went to press on Friday morning. Subjoined will, therefore, be found the record of the later work of the body, including the election. The choice for president gave great satisfaction, as Mr. Williams has not only been a loyal and enthusiastic member for years, but has taken for himself lines of study and discussion—as for example in regard to municipal ownership—that have made him a man of mark. He is one of the youngest electric light managers to fill the chair, and his very youth and activity are a pledge of continued good work for the general cause.

A notable feature throughout the week was the manner in which the "active members" stuck to their job, and would not be distracted from the regular business. A curious instance of this was given late on Friday afternoon when after a long and rather heavy executive session the "rolling chair parade" was due. President Blood put it to the meeting whether work should be dropped for the occasion, but all the 250 men present rose to their feet and voted solidly to go right ahead, let who will ride in easy chairs. Such a spirit of earnestness can only be commended, and after all the delegates did contrive to get lots of fun in during the week.

One incident that aroused interest was the selection of two men for honorary membership. The association has a list of several leaders in electricity thus distinguished, but has not added to their number for some years. It is now proposed to choose one or two contributors to the art each year or so, and in resuming the practice choice was made of Messrs. C. P. Steinmetz and T. C. Martin, the latter of whom was in attendance and mentioned the fact that it was 21 years since he had first read a paper before the association.

The total registration up to Thursday afternoon was over 1,400, and as many arrived after that time it is pretty near the actual fact to say that the Atlantic City Convention had an attendance of about 1,500, thus exceeding considerably the figures of Denver and Boston—a very healthy sign of activity and growth.

Invitations were received the last day of the convention from Norfolk, Minneapolis and Saratoga Springs asking the association to hold its convention in those places. The Committee on President's Address recommended that the matter of annual dues should receive the prompt consideration urged by the president, and that the incoming president appoint a committee to make recommendations at the next annual meeting. The arrangement for offices in the new United Engineering Building, New York, seemed to be well considered, and should adequately meet the growing requirements of the association. As to the matter of general relations with the Underwriters, the committee was decidedly of the opinion that a representative of the association be immediately retained by the association, who should devote part of his time to the question of fire hazards and harmonious relations with the Underwriters. The central exhibition idea having been successful this year should be continued wherever it is possible to make satisfactory arrangements. The policy of relieving local parties of the necessity of making financial arrangements for the annul meeting, judging by this meeting, was a wise one.

Mr. Paul Lupke, editor of the "Question Box" and "Wrinkles," presented the volume, the introduction to which was read by Mr. John B. McFeeley, of Newark. The following officers were elected for the ensuing year, in accordance with the report of the Committee on Nominations: President, Arthur Williams, New York; first vice-president, Dudley Farrand, Newark, N. J.; second vice-president, Alex. Dow, Detroit, Mich.; secretary and treasurer, W. C. L. Eglin, Philadelphia, Pa. Members of the Executive Committee to serve three years—Charles R. Huntley, Buffalo, N. Y.; F. M. Tait, Dayton, Ohio, and Louis A. Ferguson, Chicago, Ill.

CENTRAL STATION ADVERTISING.

The exhibit of central station advertising and publicity methods made by the Committee on Progress was one of the most interesting features of the convention. Unfortunately the construction of the pier did not allow the exhibit to be massed in one place, but necessitated a scattering of the display; but in the aggregate the effect was very impressive and complete. The chief contributors were the Philadelphia Electric Company, the Boston Edison Company, the New York Edison Company, the Denver Gas & Electric Company, the Portland General Electric Company, the United Electric Light & Power Company, of New York; the Chicago Edison Company, Detroit Edison Company, and the Edison Electric Illuminating Company, of Brooklyn. Some of these exhibits were quite extensive and pretentious. The Boston, Brooklyn, New York, Portland and Philadelphia companies sent a large number of original paintings, designs and drawings employed chiefly for the covers of their monthly bulletins, and this part of the exhibit represented a value of several thousand dollars, five of the water colors alone from Boston having a value of $1,250, while the New York exhibit included the famous Cooper sketches that have become so popular. All these designs and the reproductions were displayed artistically on the walls of the exhibition part of the pier, and were carefully inspected. Many of the exhibits also included samples of billboard and newspaper advertising, the Brooklyn exhibit being very rich and effective in this respect, while other exhibits included follow-up letters, etc. The Philadelphia and Chicago companies furnished part of their exhibits on revolving standards, and the Chicago Edison Company sent also one of its large date calendars and one of its huge billboard posters. The New York Edison Company included in its exhibit the handsome calendar issued for this year and the aluminum telephone rack for telephone numbers. Albums containing data as to special newspaper advertising, follow-up letters, etc., were furnished by the New York Edison Company, the Boston Edison Company and the Denver Gas & Electric Light Company, while the United Electric Light & Power Company, of New York, had a very interesting series of photographs illustrative of its billboard advertising, which has proved very successful in the Borough of the Bronx.

In addition to this spectacular exhibit the Committee of Progress did a good piece of missionary work in securing from some of the companies named above as well as from the Electric Illuminating Company, of Cleveland, and the General Electric Company, of Buffalo, a number of their monthly bulletins. These were furnished in such large editions that the committee was able to establish a booth from which not only the delegates but the public as well could obtain complete sets supplemented by other interesting material. In this manner some twenty or thirty thousand pieces of literature were given away during the four days of the convention and the interest in this feature was shown by the large demand and inquiry. Many of the central station men secured complete sets, not only for themselves but for their friends, and many intimated that they were likely to attempt similar work. On the other hand, casual visitors to the pier who secured copies were generally stimulated to an interest in the subject, and came back to the booth with inquiries as to this or that appliance or method of illumination. The chairman of the Committee on Progress, Mr. Martin, was assisted in this work by the heads of the publicity departments connected with these various companies, including Messrs. Mohr, Seelman, Nast, Smith, Gilchrist, Fredenburgh and Hammond, and the success was so encouraging that these gentlemen have determined to concentrate their efforts upon an even more complete and useful exhibit at the next convention, it being realized that this feature can not only be made annual and permanent, but can become valuable to all the active members.

ELECTRIC HEATING AND THE RESIDENCE CUSTOMER.

A paper presented on this subject by Mr. James I. Ayer consisted mainly of a number of practical suggestions as to the introduction of electric heating goods. It has been well settled that more goods of any kind can be sold by personal presentation than by advertising. This is, in his opinion, the only way to get the largest returns at the lowest cost. It is necessary to send out articles and leave them for trial after explaining fully how to put them in operation and how they should be cared for, as well as to leave complete printed instructions which manufacturers usually send with each article. The customer should be called on at the expiration of a trial period, to learn his conclusions. This is better than leaving or sending a blank to sign, because it is frequently the case that further interest has been developed and other articles are wanted. If the office is centrally located on the ground floor, as it should be, an assortment of samples in glass cases should be maintained so that if a customer is interested he can be supplied at once. Exhibitions at food shows and similar entertainments prove attractive as advertisements, but direct results are usually few. The universal use of smoothing irons makes this an ideal article for first introducing electric heating devices. The success which has followed systematic efforts with this article is too well known to allow further argument in favor of its selection for such purposes. Because of the quick appreciation of the electric iron you will be called on for other devices. Using the flatiron as an opening wedge you will do well to follow with circulars or folders describing such articles as water cups, heating pads, foot warmers, milk warmers, curling irons and chafing dishes. Stove or disc heaters should always be supplied with utensils made for them with suitable proportions and with perfectly flat bottoms. The difference between the application of electric heat and other sources of heat is not difficult for any one to understand perfectly, but there is a difference and for best results this difference must be understood. The importance of acquainting yourself with the different appliances is essential in placing them with customers. Take all of the articles into your own home and give your solicitors a similar opportunity, and you will get results. Experience has shown from a great variety of sources that the number of watt-hours per meal for a person can safely be taken at 300, or 900 per day per person. Allowing, however, one kw-hour for a person, we have 30 kw-hours per month, which at a five-cent rate, is $1.50, or for a family of four, $6 per month. While these rates are absurdly low to-day, compared to lighting rates in residences, there are many cases where the service may be given from separate wires at a satisfactory profit. In his judgment the policy to pursue is to personally press the sale of small household devices constantly without complicating the situation by trying to interest customers with the larger problems until from experience with the smaller they have become prepared for further ventures. He gave a table showing the cost of heating various quantities of water a certain number of degrees at various rates for electric energy.

DISCUSSION.

Mr. Max Lowenthal, of New York, said that electric heating had now passed the fancy period and had settled down to an established business. Nevertheless the development was as yet very small. He pointed to the small number of those within reach of central station service in this country that are using such service, as showing how great an opportunity there is for development. It was not sufficient to talk and advertise heating appliances. They must be introduced by actual demonstration with the customers. With energy at 5 cents per kw-hour, all the ironing and cooking for a family of six or seven people could be done at about $6 per month, as had been shown by numerous trials. He gave a warning against attaching heavy heating devices to ordinary sockets, as there would certainly be trouble with sockets, which would result in dissatisfaction.

Mr. McCabe, of Williamsport, Pa., thought the trouble was not altogether with the slowness of central station managers to take hold of heating devices. Some of them had been willing enough to take up these devices as soon as they were satisfactory.

Mr. H. L. Wallou, of Cleveland, said that with 30-cent natural gas, as in Cleveland, cooking and water heating for a family could be done at about 90 cents per month, which made it hard to make much headway with electric cooking.

Mr. Ayer said that nevertheless the market for appliances was excellent in Cleveland. The proper course was not to go out and try to introduce the big heating devices at first, but begin with the small things which will not cost much to operate, and which will be great conveniences to customers and help make electric service popular. In the meantime central station men

should try the larger devices themselves so that when the time comes to introduce these larger devices the managers themselves will be acquainted with them.

AUTOMATIC VOLTAGE REGULATORS.

In a paper dealing with alternating-current systems of distribution and their automatic regulation presented by Mr. C. W. Stone, it was stated that there are two general types of automatic voltage regulators; regulators that are arranged to work directly or indirectly to change the potential of the generators, and regulators for operating directly on the feeders. The former of these is illustrated in the Tirrill regulator, the operating circuits of which are shown in Fig. 1.

There are two main controlling solenoids, one energized from the alternating-current generator that is to be regulated, and one energized from the exciter circuit. Each of these solenoids contains a movable iron core which is hung on a balanced lever carrying a platinum point at its other end. When the alternating-current generator is operating with a light load, the exciter voltage is at a minimum, and the pull of the exciter solenoid is therefore much weaker than when the generator

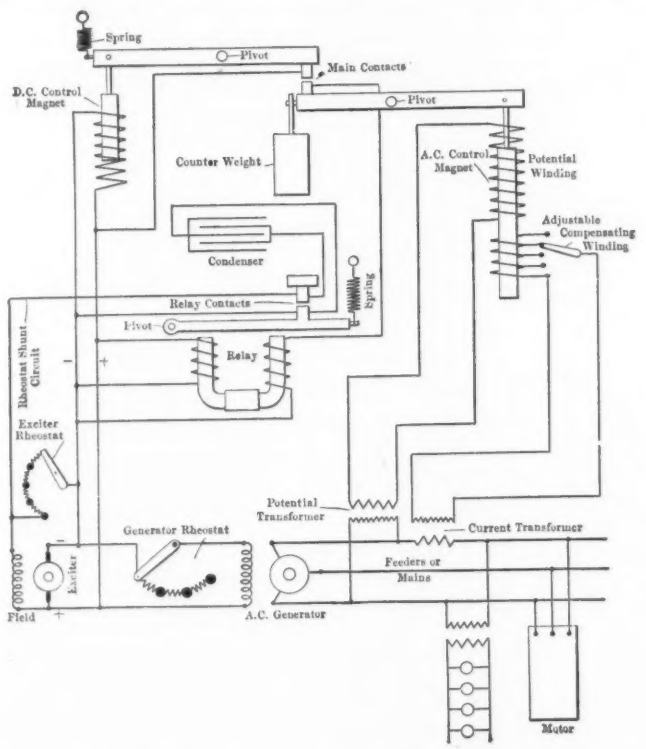


FIG. 1.—DIAGRAM SHOWING THE OPERATING CIRCUITS OF A TIRRILL VOLTAGE REGULATOR.

is full loaded, and the exciter voltage is at a maximum. It will be seen therefore that the place of contact between the platinum points varies in space relatively to the load carried by the alternator, and hence it has been very aptly termed a "floating contact." When these contact points are closed, the relay magnet is energized from the exciter circuit, and this in turn closes the main contacts that short-circuit the resistance in series with the exciter field coils. The main contact points may thus be made large and heavy so that they will not readily wear or burn away, and the power of the relay magnet insures a positive make-and-break action. By the application of a simple compounding device to the alternating-current solenoid, any desired voltage can be constantly maintained at a distant center of distribution.

There are two types of automatic feeder regulators now obtainable. Both of these types of regulators are transformers or compensators in principle. One of these depends on the movement of a dial switch and the other is dependent on the shifting of the magnetic flux through the two coils and cores. In the dial-switch type of regulator there are two sets of coils which are wound around a core like that of a core-type transformer. One of the coils is connected across the circuit, and the other coil is connected in series with the circuit, and is provided with a number of taps which are connected to the dial switch. This switch consists of three separate parts: the stationary contacts placed on the inside of a cylindrical cast-iron pot; the stationary set of collector rings; the moving part which carries the contact fingers. The moving part consists of a metal carrier which has mounted on it ten fingers of different length, all insulated from one another. These fingers bear on the contacts of the stationary part, and are also connected to the ten collector rings on the central stationary part. By thus designing the contact arms several of these fingers are in contact with the stationary contacts at the same time. If these fingers were not insulated from one another, a short-circuit would take place between the taps on the transformer. They are therefore insulated from one another and a resistance is con-

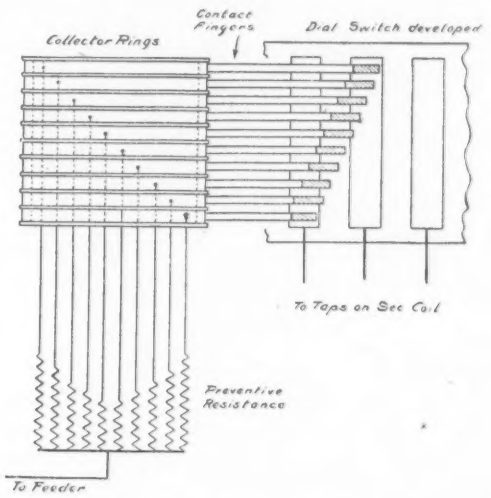
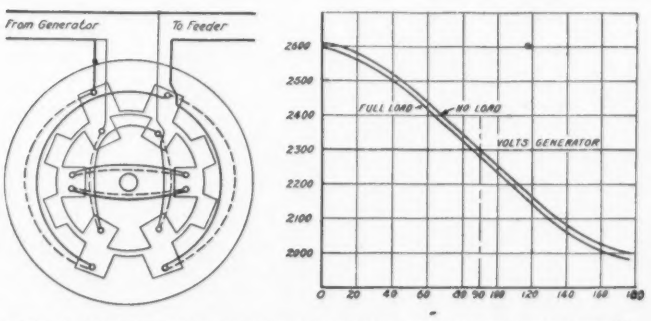


FIG. 2.—DIAGRAM OF CONNECTIONS OF SWITCH AND RESISTANCE.

nected between them, as shown in Fig. 2. Their resistance limits the flow of current between the different taps, and no sparking occurs. A potential relay serves for energizing one or the other of two motor-driven magnetic clutches which raise or lower the potential as may be required.

The second type of automatic feeder regulator is in principle a variable-ratio transformer. The regulator is made with a primary or shunt winding, which is connected across the line. It also has a secondary or series winding, which is connected in series with the line. The primary or shunt winding is placed



FIGS. 3 AND 4.—DIAGRAM OF REGULATOR AND REGULATION CURVE.

on a movable core, and the secondary or series winding is placed on the stationary core, as is shown in Fig. 3. The shunt winding produces a magnetizing flux that has a constant value, the direction of which is constant in the movable core, and consequently with respect to the series or stationary winding. The passing of this flux through the secondary coils in one direction produces a potential in these coils which is added directly to the line potential, or subtracted when the direction of the flux is reversed by rotating the primary core through an angle of 180 deg. As the core is rotated gradually, the direction of the flux, and consequently the amount forced through the secondary coils, is similarly varied, and produces gradually a varying potential in the secondary from the maximum positive through zero to the maximum negative value.

The effect of rotating the core through its entire range is represented graphically in Fig. 4, which shows the variation in the

feeder-voltage with no-load and full-load current. The slight difference in these curves is due to the loss in the regulator itself.

The rotating core is provided with two windings: The active or shunt winding connected across the lines, and a second winding which is short-circuited on itself and arranged at right angles to the former. The object of this short-circuited winding is to decrease the reactance of the regulator. If the movable core were not provided with a short-circuited winding, and it were rotated from one position to the other, a gradually increased potential would be required to force this current through the series winding; thus introducing a reactance in the feeder. By adding this winding, however, the reactance of the regulator is cut down to the minimum, and it thus has very little effect on the power factor of the line. In this respect it is vastly superior to any of the other resistance and reactance types of regulators heretofore built. The amount of reactive effect on the feeder is directly proportional to the range of regulation of the the regulator. That is, as the range in the regulator increases, the effect on the power factor of the circuit is increased; thus with a twenty per cent range on the regulator, the power factor of the feeder would be lowered only a trifle over one per cent, and with a total range of ten per cent, it will be lowered about one-half of one per cent.

The rotor is moved through a worm gearing driven by a motor whose direction of motion is determined by a potential relay inserted in the feeder circuit.

DISCUSSION.

Mr. Wallau said they were operating in Cleveland an 11,000-volt Y-connected transmission system with neutral grounded both at the main station and at all substations. He asked Mr. Stone if this was likely to cause trouble from stray railway currents. Mr. Stone did not think that with so few grounds, which were probably some distance from the railway, that there would be any trouble. In one congested area on the west side of the city they had a comparatively large district with approximately 400 kw maximum load, which was distributed entirely underground by a 3-phase 4-wire secondary system giving 115 and 200 volts, the primary being 3-phase, 3-wire at 2,300 volts. As originally installed, this secondary was well balanced, but as new connections have been made and other customers disconnected the balance became quite bad and the regulation on that type of secondary is getting hard to maintain. For that reason they had discarded the 3-phase 4-wire secondary, except where it already existed and could not be changed. They had adopted the single-phase 3-wire secondary system fed from 3-phase primaries. They are about to install a Tirrill regulator in connection with a new turbine. They have decided, however, that they could not regulate from one principal feeder alone, for the reason that they now have three substations in use, and the total number of feeders will be something like 33, the average load on feeders being from 150 to 200 kw. As the substations are quite a distance apart it is hard to regulate any particular feeder to give any kind of regulation on the others. They had adopted the use of compensators, having one compensator cut in each leg of a 3-phase primary feeder and one induction regulator in each leg of such feeders. The regulators are motor operated but controlled by the station operator, who adjusts them to keep the potential balanced as shown on the station voltmeters. They found that they had very little difficulty in obtaining good regulation by this means, and got rather better efficiency out of such 3-phase transmission lines than with a single-phase feeder system balanced on a 3-phase bus.

Mr. Hallberg called attention to the fact that lightning arresters when connected to a system on a grounded neutral should not be of the double pole type connected to each side. On such systems the double pole arresters should be connected in tandem, one after the other. Otherwise the current is likely to jump across the arresters.

Mr. Stone, in response to questions, said there are a large number of these automatic regulators in use in Chicago and Toledo. The present regulators require but little attention. The only maintenance required is to see that the bearings are well oiled and that the contacts on the potential relay are in good condition.

THE AGITATION FOR MUNICIPAL OWNERSHIP IN THE UNITED STATES; ITS ORIGIN, MEANING AND PROPER TREATMENT.

Mr. Everett W. Burdett, of Boston, addressed the national convention on the evening of June 7 on this subject. Great accumulations of wealth in the hands of a few generally employed by corporate organizations, he said, had so abused the privileges which wealth and organization puts at their disposal that the average citizen is disgruntled and inclined to demand a change of some kind which will tend to remove the inequalities of which he deems himself the victim. In short, a great socialistic agitation is upon us. He then reviewed at length some of the corporate abuses which have given rise to this agitation. Forgetting the munificent results which have been obtained only through the accumulation of great wealth derived from corporate organizations, the dissatisfied citizen sees only the abuses of financial and corporate power of which he has been, or imagines himself to be, the victim. And yet, of course, this wholesale distrust and condemnation of wealth and corporate power is unreasonable. It loses sight of the fact that we are unable to assert from what other sources the people at large would have derived the blessings which have come from the establishment and maintenance of a special fund for supporting hospitals, libraries, colleges, parks, museums and the encouragement of learning. It forgets that it has been only by the uniting of the funds of the rich and the savings of the poor in corporate organizations that the country has been developed by the establishment and exploitation of numberless forms of industrial enterprise. All the wonders of development in the central station, electric lighting, electric railway and telephone industries are due to corporations. They have given free play to the enterprise of the individual energy of our people and have made that enterprise and energy vastly more powerful and effective than it otherwise could possibly have been. And it has not been the organizers, managers and stockholders of these enterprises who have chiefly benefited by them, but the general public. A glance at the net divisible incomes earned and the dividends paid by the electric public service corporations of the United States, contrasted with the character and extent of the service rendered, will furnish ample demonstration of this assertion. He then cited as an example the electric light and railway companies of the State of Massachusetts, where only about one-third of the 58 strictly electric lighting companies paid a dividend in 1905, and the dividends paid ranged from 4 to 10 per cent.

He reviewed at length the agitation in favor of municipal ownership in England. He pointed out that successful English methods were not necessarily successful in the United States under our different conditions. Municipal ownership, he pointed out, was undertaken in England as the means of accomplishing undertakings which would not have been entered upon by private corporations, rather than as a substitute for private corporate enterprise. He then gave an outline of his ideas as to the proper treatment of the present agitation for municipal ownership. In the first place the companies engaged in furnishing public services must in their own interests strive more and more to give good service at fair rates. He who serves the public best serves his company best. Second, the abuses of great wealth and corporate privileges, to which he had already alluded, must cease, these abuses being overcapitalization, poor service, high prices, discrimination between consumers, and, above all, the attempt to control the law making power for selfish ends. He did not include among these objectionable practices that reasonable inflation of capital necessary to induce men to embark in new enterprises where to offset the chances of loss the amount of possible profit may reasonably be increased over that of ordinary investments. For such an inflation we have the warrant of the Supreme Court of the United States and the recent statement of President Elliott, of Harvard, that much can be said in defense of it. The difference between such an inflation and the objectionable stock watering referred to needs no elaboration. Third, the public must be educated in sound, economic lines. Except as a choice of necessary evils, municipal ownership has no standing in the court of economics. It is not sufficient in itself to effect the results desired, nor is it the best means which can be employed for the purpose.

The State of Massachusetts has for twelve years been trying the experiment of public control of gas, electric lighting, railroad,

street railway and other public service corporations, and has developed a most complete system. While there are imperfections in the system, and there is at times in specific cases dissatisfaction with its application, it has been on the whole an advantage to all concerned. It is by no means perfect; it might easily be made intolerable, but the sober sense of the people of Massachusetts, as represented in their legislative assembly, has prevented any gross perversions of its objects or confiscatory applications of its principles. The public is better and more cheaply served and the capital employed is more amply protected. The relations of producer and consumer are more satisfactory than is the case in most, if not all, other portions of the country. The evils of stock watering have been eliminated or minimized, while reasonable returns upon legitimate investments have been insured if earned. Such laws unwisely framed or viciously applied could do an immense amount of damage, but in the older of our communities certainly, where the people at large are to be credited with a reasonable degree of intelligence, and a real desire for a "square deal" for all alike, it offers in his opinion a vastly better solution of existing difficulties than does municipal ownership.

NEW ILLUMINANTS.

Prof. H. E. Clifford presented a paper giving a review of the recent developments in low consumption lighting units. He discussed the 2.5-watt graphitized filament lamp, the 1.85-watt and 2.2-watt tantalum lamps, the 1.5-watt osmium lamp, the 1-watt Kuzel metallic filament lamp, the luminous arc lamps, the Nernst lamp, the Cooper Hewitt mercury vapor lamp and the Moore vacuum tube lamp. He stated that the results already achieved with osmium, tantalum and zirconium have greatly stimulated the search for a substitute for the carbon filament. Until, however, these metallic filament lamps run equally well in all positions, give satisfactory service on both alternating and direct-current circuits, operate at commercial voltages and can be manufactured at a much lower cost, the carbon filament lamp with reasonable rates for electricity and the development indicated by the recent gain in efficiency, will continue to maintain the supremacy it has so long enjoyed.

The production of fumes and the lack of steadiness have combined to render the flame arc lamp undesirable for interior illumination, although it is claimed for one of the most recent types that these objectionable features have been overcome. For street lighting too large a proportion of the light falls near the vertical, although undoubtedly some reflector might be devised to remedy this defect.

As a scientific principle it may be stated that the most efficient means of obtaining light from electricity is electrical conduction through rarefied gases or vapors. The Cooper Hewitt and the Moore lamps represent the present-day commercial systems of vapor lighting. The mercury vapor lamp possesses the disadvantage of lacking in red rays. The best way of supplying the lacking rays is to use incandescent lamps in conjunction with the mercury vapor lamp. The writer stated that the Moore vacuum tube lamp has a promising field in the illumination of large areas.

He concludes that the concentration of effort in the securing of higher efficiency tends to make one lose sight of the danger of further increasing the intrinsic brilliancy, a danger all too plainly indicated in some of our modern illuminants. The last word in increased efficiency has not yet been spoken, but even so the time seems ripe for greater devotion to questions of distribution.

The paper gave photometric tests on a 125-watt General Electric new high-efficiency carbon filament lamp, both with and without reflectors, and both frosted and unfrosted. The mean spherical candle-power of the lamp without reflector or frosting is about 40, thus giving a consumption of about 3.1 watts per mean spherical candle.

Tests were also given on a number of flaming arc lamps, including the magnetite arc made in this country and several flaming arc lamps made in Europe. A fuller abstract of this paper will be published in a later issue.

DISCUSSION.

Prof. Clifford said, in presenting his paper, that he was a poor advocate of the high-efficiency metallic filament incandescent lamp. In the first place, most of these new metallic filament lamps are made for voltages far below those in common commercial use. He cited some tests carried out by the Electrical Testing Laboratories of New York, and also some which he carried on personally on some tantalum lamps operated on 133 and on 60-cycle alternating current. Of ten such lamps on 133 cycles, five with clear and five with frosted globes, not one gave a life of more than 99 hours; the average of the clear bulb lamps was 37; the average of the frosted bulb lamps was 46. On the 60-cycle test the maximum life of any lamp was 308 hours; the average life of the clear bulbs 178, and the average life of frosted bulbs 129. He had a feeling that the tantalum lamps which were originally put on the market were much better than the tantalum lamps of recent manufacture. Then, too, the fact that tantalum lamps are suited only for direct-current service greatly limits their usefulness. In closing he urged very strongly consideration of auxiliary devices for saving stray light. Saving this light is quite as important in the present state of development as the focusing of our attention wholly on the question of high-efficiency illuminants, and in doing so failing to consider how we may get a cheap illuminant (perhaps not quite so efficient), and improve it by using the light which is now thrown away.

Mr. D. McFarlan Moore was called upon to give further information about his vacuum tube lamp, one of which was in commercial use on the pier. He stated that the consumption of this tube as a light source was 1.5 watts per candle. The candle-power of the tube was 2,200, and the total wattage of the tube was 3,300. The great field of usefulness for this tube will be lighting large areas. Eighty per cent of all the incandescent lamps in use to-day throughout the world are used for lighting large areas. He claimed the gain and efficiency was between 75 and 67 per cent over ordinary incandescent lamps. The vapor in the tubes will now last indefinitely. Repairs can easily be made by glass plumbers. It is now possible to illuminate any area with no wires or purely electrical apparatus in the area. Several thousand feet of this tube are now in commercial use. A tube can be repaired and refilled with gas in about an hour. The power factor is about 75 per cent.

ECONOMY FROM USING GRAPHITIZED FILAMENT LAMPS.

A paper read by Mr. F. W. Willcox before the convention of the National Electric Light Association at Atlantic City gave an exhaustive discussion of the effect on central station service of the introduction of the General Electric graphitized-filament lamp. It is stated that the new type of lamp saves 20 per cent in the energy consumed for the same candle-power and life, or it will give 25 per cent more illumination for the same candle-power and cost for energy and maintenance. It is assumed that the new lamp costs 20 cents as compared to 16 cents for an ordinary carbon-filament lamp for the same illumination; that is, from 16 to 20 cp. The author gave estimates to show that a customer can buy his own renewals of the new 2.5-watt lamp and save money at all rates for energy above 5 cents per kw-hour in comparison with paying merely for the energy for the ordinary lamp consuming 3.1 watts per candle. From the viewpoint of the central station manager the important features of the low-consumption lamp reside in the improvement in service in meeting and resisting competition, in adding desirable business, in improving the load factor and in the resulting increase in net earnings. In order to cope with the competition of the Welsbach gas lamp an incandescent lamp should have a candle power greater than the usual 16. The author suggests that the standard low-consumption unit should be a 20-cp, 2.5-watt lamp. This plan gives the central-station company the same output per consumer as at present, thus avoiding the necessity of having to increase the number of consumers or the number of lamps per consumer.

DISCUSSION.

President Blood thought the gist of the paper was summed up in the one paragraph which read: "The central station cost standpoint is not the correct basis on which to determine the proper efficiency of lamps where light is sold by the kilowatt-hour. It neglects to consider the effect upon the customer and the selling end of the business. Whether a central station supplies free lamp renewals or not, and whether its costs are thereby changed or uneffected, the success of the business demands the

lowest practical cost to the customer; that is, it requires the use of high efficiency lamps of that efficiency which gives the lowest cost of light (including power and lamp renewals) at the rate paid."

Mr. A. C. Dunham, of Hartford, Conn., thought the metallized filament lamp the greatest improvement made in electrical appliances in the last five years. The complaint most usual among customers was that they could not get enough light for the money they paid. They pay all the money they can afford and are hungry for more light. This company had doubled its output every 3½ years for the past 10 years, and had done it without any solicitors. He believed this was due entirely to a steady decrease in the cost of light. The first four months of this year their output has been increased $28,000, of which $4,500 per month was for light. He believed this entirely due to the use of Meridian and similar lamps with reflectors which would deliver the light just where it was wanted. They had reduced their prices steadily for five years. Every time they reduced the price they increased the output and increased the profit. He had experimented with the tantalum lamp and found that to secure a long life it could not be disturbed after it had burned the first 50 hours without shortening its life.

Prof. Clifford thought that one of the alternatives suggested in Mr. Willcox's paper, namely, that of increasing the rates to make up for increased cost of lamp renewals with high-efficiency carbon lamps, was entirely impracticable.

THE EDISON SYSTEM OF SOUTHERN CALIFORNIA.

A paper by Mr. R. H. Ballard gave an outline description of the Edison Electric Company's system in Southern California. This system was treated at some length in our issues for February 24, March 4, March 11 and March 25, 1905. The plans of the company contemplate the eventual construction along the Kern River of four water power plants, in addition to the one now nearing completion. The water head will vary from 340 to 1,200 ft., and will give a total output of 50,000 kw at the ordinary low water flow of the stream.

In discussing the character of the load on the system, the author stated that there is a certain kind of power business which is perhaps peculiar to Southern California, and this is of importance, owing to the conditions under which the power is required. Owing to the fact that for six months in the year no rain falls, it is necessary to do a large amount of irrigating. Only a small proportion of the water needed has a natural flow, and as a consequence the requirements of the country have largely to be met by pumping water from beneath the surface. The pumping season usually lasts from the first of May until the end of October; fortunately, just at the time of the year when there is the least demand for electricity for lighting purposes. As a rule, the pumping plants are operated during the day hours only, and the very great number of these plants that are being operated in all the districts is a considerable factor in the building up of the day load.

THE LONDON SLIDING SCALE.

Mr. W. H. Gardiner, Jr., prepared an elaborate description containing 133 printed pages in addition to three tables dealing with the London sliding scale as a method for the government regulation of public service corporations. The principle of the London sliding scale is a permanent arrangement between the public and the corporation whereby net allowable earnings interdependently go up as prices go down, and vice versa. The basic factors of the scale are the sliding dividend and net earnings; the initial price and reductions; the ratio of increase in net earnings to decrease in price.

The essential point in the determining of the standard dividend is that it shall yield a dividend commensurate with the investments in the business and a fair return from the conduct of the business as a going concern under present conditions. The uniform practice seems to have been to fix the initial price a very little above the price that would be necessary to but exactly meet in amount the interest and dividend charges under the old or new capitalization. The initial sliding scale price is thus usually raised by a slight increase above the old price. The object of so fixing the initial price may be found in the desire of the public and its officials to induce lighting companies to adopt the sliding scale system because it works so well to the public good. Therefore, the initial price may be set at a slight advance over the former price so that the company may forthwith make a reduction therefrom and consequently increase the amount of its dividends. The practice in connection with the ratio of increase in net earnings to decrease in price has been to allow the company to increase the rate of its dividends by a constant and predetermined amount for each reduction of stated size from the initial price, and conversely. The stock of an English company may thus be allowed to pay, say, at the rate of one per cent more for each reduction of, say, one cent from the initial price per kilowatt-hour. Furthermore, this ratio is constantly maintained.

The writer stated that the initial price, returning a fair earning on the initial capital should be the average price per unit of service at the initial period, unless economic results and equity to all concerned are to be wilfully sacrificed to sociological expediency. In this latter event the initial list price may be substituted for the initial average price. The net premium earnings should be only such as will most efficiently, economically and equitably stimulate the company to the best service of the public in every respect. The net premium earnings are best fixed by allowing them to equal the actual money saving the company's efforts effect for the public, as indicated by the periodic reduction in the index price and the contemporaneous volume of the service. Deficits and surpluses in earnings and reductions should be carried forward for eventual balance. The period of duration of a sliding scale agreement should be of at least such length as to warrant the company in operating practically on a permanent basis. The English practice is not to limit the duration of the agreement, but to provide for occasional revision.

RATES FOR CENTRAL STATION SERVICE.

The committee on rates and costs, which was composed of Messrs. C. L. Edgar, L. A. Ferguson, S. Scovil, F. W. Frueauff, P. G. Gossler and R. S. Hale, submitted a report on various methods for determining the maximum demand for electricity made by each customer. Eight methods were considered, as follows:

1. The connected load method. This consists in taking the maximum load that can possibly be thrown on the station if all the customer's lamps are used at one time. A minor point of interest, if this method is used, is the question as to whether motors should be taken at their rated power or at their overload capacity.

2. The demand may be taken, not at the connected load, but at the maximum power that can be thrown on the station as limited by a flicker device or circuit-breaker. A minor point, if this method is used, is as to whether the customer should be entitled to change this amount from month to month, or whether he should make a year's contract for the amount of demand that he may use.

3. The demand may be determined by a Wright or other form of demand indicator and the bill for each month calculated according to the monthly readings.

4. The demand may be determined from a Wright or other form of demand indicator, read yearly, and yearly settlements made. A minor point, if this method is used, is as to whether the highest reading of the demand indicator should be used, whether the average of three or four of the highest readings should be used, or whether the average of three or four winter readings should be used. Another variation of this method is the original method used at Brighton, by which the highest readings of the indicator during the six months from January 1 to July 1 and from July 1 to January 1 are taken, and half yearly settlements made.

5. Another method is the method used in Boston, by which the yearly readings of the demand indicator are used, but, instead of making yearly settlements, the reading of the demand indicator for one year is used as a basis for all the months the next year, thus enabling monthly settlements to be made. A minor variation of this method is as to whether the single highest reading should be used or an average of two or more of the readings.

6. The Detroit method is to estimate the demand for residences

in proportion to the number of rooms in the house, paying no attention to the demand.

7. A variation of the method of taking connected load is that used at Cleveland and New York, by which only certain portions of the connected load are taken. Thus, in New York, only the lamps and motors are taken, the heating and miscellaneous devices not being considered. In Cleveland only the lamps connected in the living rooms of the house are considered, lamps in halls, bedrooms, etc., not being included.

8. Another method that is frequently used in the case of power is to estimate the demand by the judgment of the central station manager, or by a single test. Another method, which, strictly speaking, is not a method at all, but a way of getting around the use of the demand, is to consider different classes of business as uniform among themselves, and to make one rate to apothecaries, another to residences, another to saloons, another to elevators, etc.

LAWS RELATING TO THE THEFT OF ELECTRICITY.

The report concerning the laws of the several States and jurisdictions of the United States governing the theft of electricity which was originally prepared by Mr. Robert L. Elliott in 1903 has been revised by Mr. E. H. Davis for the National Electric Light Association. With the exception of Alabama, Arkansas, Delaware, Indian Territory, Kansas, Mississippi, Missouri, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Vermont, West Virginia and Wyoming, all of the States and Territories, the District of Columbia and Porto Rico have laws on this subject. In most of the States the offense is considered a misdemeanor and is punishable by a short term of imprisonment or by a small fine. Mr. Davis states that the laws enacted by most of the States are capable of considerable improvement. A proper and satisfactory law should forbid and provide:

1. Fraudulently making any connection with any electrical connection, or fraudulently diverting electricity in any other manner whatever so as to use or waste it, without the consent of the company, or without the electricity passing through a meter set by the company; or fraudulently preventing any meter from duly registering, or altering its index, or interfering in any manner with its proper action or just registration.

2. Any one aiding or abetting or counseling the above acts to be equally guilty with the principals.

3. A penalty of a fine not exceeding $500, or imprisonment not exceeding one year, or both.

4. Proof that any of the above acts were done on the premises of the accused, or that he received the benefit of such electricity fraudulently obtained, shall be *prima facie* evidence of his guilt.

In our report of the National Electric Light Convention last week, on page 1227 the discussion by Messrs. Rhodes, Partridge, McCabe, Wells, Hutchinson and Morrison, printed as part of the discussion on the "Grounding of Secondary Circuits," should have been inserted as part of the discussion on the paper by Mr. Paul Spencer on "Overhead Line Construction."

Telephone System in Wanamaker's Philadelphia Store.

We called attention in our issue of April 14 to the elaborate system of conduit installed in the Wanamaker store at Philadelphia for low-potential circuits; that is, for telephone, fire alarm, call bell and signal service. We are now enabled to give some information on the very complete telephone system in use in that portion of the building already complete. Almost 19,000 miles of telephone wire are connected to a switchboard requiring twelve operators. There are at present in use 2,000 telephones with 1,000 more to follow. One hundred and twenty trunk lines connect the Wanamaker store with the Bell Company's central offices, the trunks being distributed so as to terminate in several offices in order to prevent congestion of traffic. The reason for this distribution is obvious when it is understood that possibly 6,000,000 messages, incoming and outgoing, will pass over these trunk lines within a year. The telephones afford almost instant communication between every part of the store, and at each instrument is an automatic coin box, making every telephone a pay station for the convenience of customers. It is expected to add more sections to the switchboard as the other portions of the store are completed. The telephone plant is built exactly on the lines of a large city exchange, and a twenty-four-hour service is maintained, operators being on duty day and night. The equipment is indicative of the absolute necessity of the telephone in modern department store systems. Time was when one or two telephones were considered adequate for most establishments; but the convenience and value of the telephone for department store work is now appreciated. The satisfaction of speaking directly with one's regular salesperson, or with the clerk who handles and knows most about the classes of goods desired, adds considerably to the prestige of this, the largest store system in the world.

New Telephone Patents.

METAL LAMP SOCKET.

M. Setter has invented a metal frame lamp socket strip with a hard rubber face strip. The plate is pressed so that a ridge is raised at the rear upon which the socket springs are built up. Incidentally a recess for the screw heads is formed. In order to prevent a confusion due to light breakage, a wall of metal is bent up from the strip at one side of each lamp mounting.

AUTOMATIC APPLIANCES.

When a fire call wire is connected to an automatic system of the Strowger type, there is trouble in case of false alarms due to the inability to locate the culprit. Some time ago a method was devised for overcoming this difficulty, but it disabled the machine for the time being. J. Erickson, of Chicago, has now patented a signal, one of which is associated with the switch of each line, and this signal becomes displayed only upon a call of fire from the corresponding instrument, and it in no way interferes with the proper operation of the instrument. T. G. Martin has patented an attachment for the same automatic system, by means of which storage batteries at an associated exchange may be charged over the trunks at idle times. This is, of course, an adaptation of a well-known practice in manual systems.

LETTER TO THE EDITORS.

Water-Wheel Tests.

To the Editors of Electrical World:

SIRS:—In your issue dated May 26 appear the data of some tests made on the Pike's Peak Hydro-Electric Company's wheels at Manitou, which I think call for some explanation.

Mr. Taff claimed that the wheels were not developing the guaranteed efficiency, and the writer was asked to go there and be present at an efficiency test. As soon as I reached Manitou and examined the wheels, I told Mr. Taff it appeared to me that there was a great deal of air in the water. One thing which indicated this was the wear on the buckets and wheel center. Some of the water was taken out of the tanks into which the wheels discharged, and it was found to contain a good deal of sand. The water, under such a high head, of course would compress the air very greatly, and as soon as the water left the nozzle, this air would expand and throw water and sand against the wheel centers and buckets, and act very much like a regular sand blast. These conclusions were reached before I saw the manner in which the water was taken into the pipe. My conclusions were explained to Mr. Taff, but he did not agree with me because he said he had a riser on the pipe which allowed the air to escape.

As stated in the article, both the pipe and riser are 20 in. in diameter. The effective head is 2,100 ft., and when two machines are running this means a velocity of some 4 ft. per second in the pipe, or 2 ft. when one wheel is running. Anybody who knows anything about hydraulics can see that but a very small portion of the air could possibly escape through the riser. Upon going up to the intakes I found the water was taken into

the pipe from three little ponds with practically no means of preventing sand and dirt from entering the pipe, and a man was employed to rake the sand away from in front of the intakes. A part of the pipe on top of the mountain is common tile pipe and the joints are very poor. The velocity of the water in this is so high that the pipe is above the hydraulic gradient and consequently a negative pressure exists in the pipe. At quite a number of places I could hear the air being drawn into the pipe.

As I explained to Mr. Taff, I did not consider a test under such conditions a fair one.

New York, N. Y. Geo. M. Peek.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Alternating-Current Commutator Motors.—Fynn.—The first part of an article in which the author endeavors to give, with the aid of diagrams, a classification of alternating-current commutator motors which has a rational basis. The author starts with some remarks on the "repulsion motor"; he believes that the use of this term has brought about considerable confusion.—Lond. *Elec.*, May 25.

Commutator Design.—Livingstone.—In a continuation of his article on the design of commutators for direct-current generators the author gives mathematical formulas for the stresses in commutators.—Lond. *Elec.*, May 25.

Lamps and Lighting.

Mercury Arc.—Bastian.—A paper read before the Glasgow section of the British Inst. Elec. Eng. on observations on the mercury arc and some resultant problems in photometry. The author distinguishes between the mercury arc lamp which has mercury electrodes and the mercury vapor lamp containing mercury vapor electrodes of iron or carbon. The author refers to the altogether unexpected gain in luminosity which is obtainable by combining the characteristic green light of the mercury arc with the red light of the carbon filament lamp. Every color produces a certain degree of visual effect and white light produces the greatest visual effect of all. He thinks it is reasonable to conclude that an actual gain is effected by combining two colors to produce white light. He refers to some tests made at the Central Laboratory of Electricity in Paris where a mercury lamp tested at 1.86 meters from the standard was returned as being of 14 cp, but when tested again the same standard at the increased distance of 21.5 meters it was returned as being of 25 cp. The explanation offered was that a discrepancy was due to the Purkinje phenomena, but the present author adduces two additional causes; first, the difference in the intrinsic light density of the two illuminations and second the different resistances offered by the atmosphere to the passage of different luminescent wave lengths. The law of inverse squares is based on the fact that light rays diverge in a definite manner and on the assumption that the source of light is a point. But this is not true with the mercury lamp. The intrinsic light density of a carbon arc lamp as compared with a mercury arc lamp is about the ratio of 40,000 to 10 as nearly as can be computed. Concerning absorption of light the author reaches the conclusions that the penetrating quality of light is a function of the light conductivity of the atmosphere, the conductivity of which is different for each distinct wave length. The absorption of light in the atmosphere between any source of light and an illuminated body varies directly as the density of the light at its source, all other conditions being equal; and it also varies directly as the distances vary between the source of light and the illuminated body. The author then describes some observations made on mercury lamps. One of the earliest difficulties encountered in the construction of a mercury arc lamp arose from the fact that the mercury apparently migrated from the positive electrode through the arc to the negative electrode, and consequently, sooner or later, the positive electrode became depleted of all its mercury; arcing then took place from the platinum leading-in wire, which, becoming hot, cracked the glass around it and destroyed the lamp. It did not seem possible that this migration of mercury was due to vaporization from a hot positive electrode and condensation at a cooler negative, because all the observations seemed to indicate that the positive was the cooler of the two. He thinks that "the migration was due to an attraction of mercury atoms from the positive to the negative electrode through the arc." In order to compensate for this the author produces an opposite transfer by means of evaporization of mercury at the negative electrode and condensation at the positive electrode by making the surface of the negative electrode smaller than that of the positive electrode. When an arc is struck by separating the column of mercury in the center of a small, straight tube, the mercury forming the positive electrode steadily recedes as the formation of vapor in the arc increases the pressure; but the mercury forming the negative electrodes does not recede steadily in the same way; but on the contrary commences a regular pumping motion, to and fro, and unless the burner is specially constructed to prevent it, this pumping motion continues indefinitely. No satisfactory explanation can be found, unless it be caused by the impact of mercury atoms attracted from the positive. Another observation that might be suggestive if it were not so inexplicable, is that two mercury arcs cannot be struck between one common negative and two positive electrodes. It is possible to modify the color of the mercury arc light almost as desired by alloying other metals with the mercury, but it has not yet been found possible to do this except at great sacrifice of life and efficiency.—Lond. *Elec.*, May 11.

Tantalum Lamp.—A note stating that the price of the tantalum lamp in England has been reduced from $1.25 to 68 cents, and this will doubtless considerably extend its sphere of utility.—Lond. *Elec.*, May 18.

Measuring Illumination.—Uppenborn.—A translation in abstract with several illustrations of his German article which was recently noted in the Digest.—Lond. *Elec.*, May 18.

Traction.

Liverpool Tramways.—An abstract of the annual report of the municipal tramways of Liverpool for 1905. The total number of cars in service was 479, the average number of miles run per car 2,452. The total electrical energy used during the year 1905 for tramway purposes was 21,186,782 kw-hours (including 315,780 kw-hours for lighting of car sheds, works and routes, and power for works motors) as against 20,045,629 units for the year 1904, an increase of 5.69 per cent. Of the above quantity 1,047,918 kw-hours were supplied by the Bootle Corporation. The average kw-hours used per car-mile has been as follows:

Year.	Kw-hours used per car-mile.	Percentage increase over preceding year.
1903	1.448	6
1904	1.566	8
1905	1.677	6

The average charge made by the Electric Power and Lighting Committee for energy supplied during the year 1905 was 2.214 cents per kw-hour, as against 2.318 cents during 1904, being a decrease of 4.4 per cent. The price charged for energy includes the total working and capital charges and delivery of the electricity at the section boxes. The percentage of operating costs to total revenue was 65.9 per cent in 1904 and 67.3 per cent in 1905, and the passengers carried per car-mile amounted to 9.88, as against 9.58 in 1904.—Lond. *Elec.*, May 11.

Motor Vehicles.—McGeorge.—A discussion of the heavy motor vehicle in practice, with a comparison of electric propulsion with steam and oil motors. The author deals with the subject "from the American point of view" and says that the electric truck "seems to have its advantage for short hauls, for goods that would be affected by gas fumes or damp, or where quietness is an essential, or where a natural source of power, such as a waterfall, is available. But nearly all the advantages inuring to the steam and electric systems for commercial work are closely approached by the gasoline engine."—*Eng. Mag.*, June.

Installations, Systems and Appliances.

Compounding.—NOUGUIER.—In order to keep the voltage at the bus-bars constant with varying load in a direct-current station the author recommends the use of shunt-wound generators in combination with boosters in the excitation circuit, as indicated in Fig. 1. The field poles of the shunt dynamo, *G*, must not be too highly saturated, since the method requires that an increase of the exciting current produces a noticeable increase of the magnetic flux. The exciting winding must be made from wire thick

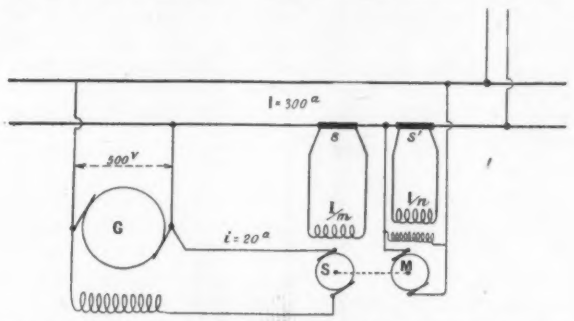


FIG. 1.—DIAGRAM OF DYNAMO AND BOOSTER CONNECTIONS.

enough to withstand a considerable increase of the exciting current. If a small booster, *S*, is inserted in the exciting circuit of *G* and if the current, *I/m* passes through the exciting winding of *S* (where *I* is the total load current and the exciting winding of *S* is connected in parallel to the terminals of a suitable resistance, *s*, in the main circuit), then the voltage at the terminals of the field winding of *G* and the excitation of this machine will increase with an increase of the load current, *I*, and consequently the voltage at the terminals of *G* will rise. However, no exact compounding is possible in this way for two reasons: first, the additional voltage furnished by *S* is not proportional to the excitation, *I/m*, on account of saturation and armature reaction in *S;* even if the increase of the voltage at the terminals of the field winding of *G* was proportional to the increase of the main current, *I*, yet the voltage at the brushes of *G* would not rise in the proper proportion necessary to compensate for the total armature reaction of *G* at any load, since this reaction increases more quickly than the main current. Therefore, if exact compounding is obtained, for instance, at full load, the machine will be overcompounded at less than full load. Let us now provide the motor, *M*, which drives *S* with a winding of thick wire, in parallel to a resistance, *s'*, in the main circuit, so that the current, *I/n*, passes through this winding. If the direction of the flow of this current is such that the action is differential (i. e., that this action weakens the field of *M* when the current, *I*, increases), then the speed of *M* and *S*, and therefore the additional voltage produced by *S* will increase simultaneously with the main current, *I*, and this effect will be added to the effect described before. This second method, however, has the same disadvantages as the first one. The additional voltage gives a greater compounding effect for lower loads than for full load; first, the increase of speed is not proportional to the diminution of the exciting ampere-turns, and, second, the increase of the additional voltage generated by

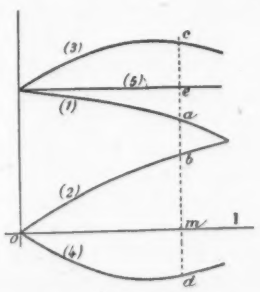


FIG. 2.—VOLTAGE CURVES.

S is not proportional to the increase of the speed. If we combine, however, both methods in such a way that we employ the first method in an exaggerated manner (overcompounding) and compensate this effect by the second method (by passing the current, *I/n*, through the thick wire excitation winding of *M* in such a direction that its action increases the magnetic flux of *M* with increasing main current, *I*), then by properly proportioning everything it is possible to produce exact compounding at any load. Fig. 2 illustrated diagrammatically the above considerations. Curve (1) represents the voltage at the brushes of *G*, where there is no compounding; (2) is the additional voltage produced at the brushes of *G* when *S* revolves with constant speed; (3) the voltage at the brushes of *G* when *S* revolves with constant speed; (4) the negative voltage produced at the brushes of *G*, due to the decrease of speed of *M* and *S;* (5) is the voltage at the brushes of *G* if the two methods, described above, are employed, the second compensating for the first. It is then $m\,e = m\,a + m\,b - m\,d = m\,c - m\,d =$ constant. In the case of a central station with several identical generators, like G_1, G_2, G_3, etc., in Fig. 3, it is feasible to use one single booster for the whole station, if both *S* and *M* are shunted by as many resistances, *s* and *s'*, in parallel as there are machines. The following advantages are claimed for the method. The generators, *G*, are shunt-wound and their operation in parallel is extremely simple.

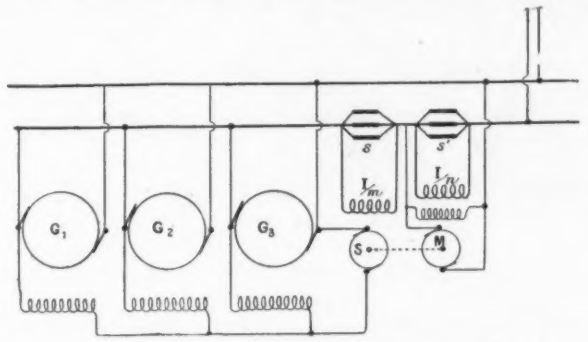


FIG. 3.—ONE BOOSTER AND THREE GENERATORS.

The booster needed is a very small machine. For instance, if the generator, *G*, gives 600 amp. at 500 volts (300 kw), the exciting current will be not more than 20 amp. and the additional voltage required for compounding 100 volts. Both *S* and *M* may then have a capacity of 2 kw. In the case of a simple booster for three 300-kw generators (Fig. 3), *S* and *M* must have a capacity each of 6 kw. This method of compounding can be employed with two stations, situated at a distance from each other and supplying current to the same network. This method may be easily employed in stations containing shunt-wound generators, if the field of the same is not too highly saturated and if the excitation winding has a sufficiently large diameter.—*L'Eclairage Elec.*, May 19.

British Central Station Finance.—An abstract of an annual report of the Ipswich municipal lighting and tramway station. The following figures give a comparison between the results obtained at Ipswich and the average of 176 other municipal stations, the figures meaning cents per kw-hour.

	Coal, etc.	Oil, waste water, and stores.	Wages of workmen.	Repairs and and maintenance.	Total works costs.
Ipswich	0.92	0.060	0.592	0.284	1.856
Average of 176 towns.	1.10	0.152	0.560	0.462	2.274

The number of kw-hours sold for lighting at Ipswich were 235,749, for power 159,734, for traction 728,020; hence the total number of kw-hours sold was 1,123,503. The generating cost was 1.678 cent, the distributing cost 0.178; hence total works cost 1.856; management charges 0.566, hence total costs excluding capital charges, 2.422 cent; and total cost, including interest and sinking fund, 4.490 cents. The capital expenditure on permanent way per route-mile is approximately $27,350, on overhead equipment $4,740, and on feeders and mains $2,565.—Lond. *Elec.*, May 18.

Wood as Insulator.—WERNICKE.—A discussion of the influence ot a polish on the insulating properties of wood. Several kinds of wood were tested. Even if the polish is applied with great care the insulating qualities of wood are not improved. Polished switch handles of wood have no advantage over unpolished ones with respect to their insulating strength. It is practically impossible to polish a handle of wood without flaws since any polish suffers by the influence of the weather and by the continuous handling of the wood.—*Elek. Zeit.*, May 17.

Canvassing.—BROWN.—In an article on "getting new business for electric central stations." the author recommends the organiza-

tion of a special department for cataloging and tabulating all kinds of data which are to be used later on by the canvasser for new business. Some remarks are also made on the hiring of motors and kindred subjects.—*Cassier's Mag.*, June.

Wires, Wiring and Conduits.

Wiring Regulations.—A set of rules proposed by a committee of the German Association of Elec. Eng. concerning the construction of plug sockets in which mistakes in the current strength are made impossible by using different distances between the plugs for different currents, while mistakes in polarity are made impossible by making the diameters of the plugs different. The regulations proposed are discussed in an article by Hermann. Another set of regulations refers to the construction of insulating pipes covered with a metal tube or wound with metal strip for protecting cables. This set of rules is discussed in an article by George.—*Elek. Zeit.*, May 10.

Units, Measurements and Instruments.

Single-Phase Induction Meter.—An official communication from the Reichsanstalt, describing a single-phase induction meter of the Allgem. Elek. Ges., which has been admitted by this bureau for calibration. The instrument is essentially a two-phase induction motor with a magnetic brake and a counting device. The general construction is indicated in Fig. 4, which shows the revolving aluminum disc, *A*. The connections are shown in Fig. 5. The aluminum disc revolves in the gap between the terminals of the three iron cores, E_1, and the iron piece, E_2. The two iron cores, E_1, at the two sides are provided with the shunt winding, f_1 and f_2, in series with an inductance, *D*, and in parallel with a non-inductive resistance, *w*. The middle core, which is shorter than the other two, has the main winding. In the shunt winding a current flows which lags about 80° in phase behind the applied voltage (for the mean width of the adjustable air-gap of the inductance, *D*). The provision of the resistance, *w*, in parallel with f_1 and f_2 has the effect that the eddy currents generated by the shunt winding flux in the aluminum disc are in phase with the flux of the main current for non-inductive load and that the eddy currents produced by the main current flux are in phase with the shunt field. The reaction of each of the two fields upon

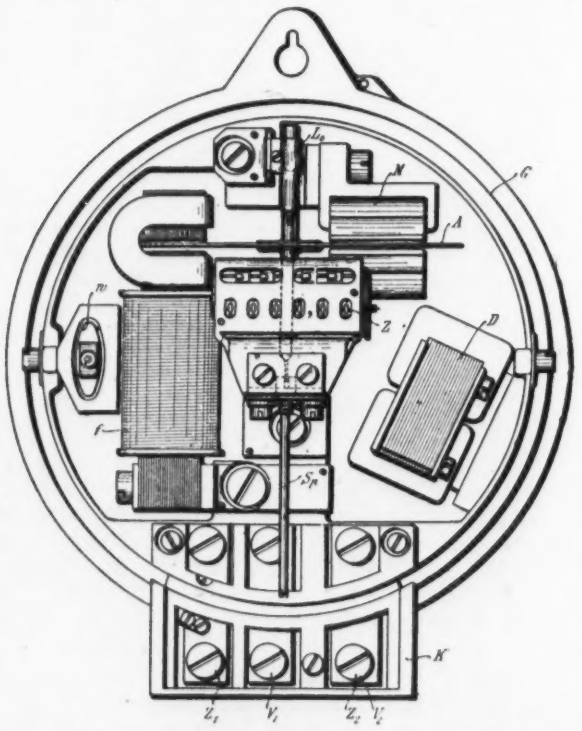


FIG. 4.—SINGLE-PHASE INDUCTION METER.

the eddy currents produced by the other produces a force which causes the disc to revolve and which is proportional to the main current, the voltage at the terminals and the cosine of the phase different between the same. The power is consumed partly by friction and partly by the eddy currents generated by the braking magnet, *M*, in the aluminum disc. To compensate for the friction, a small additional torque is produced by fastening an adjustable iron sheet to the front core. In order to prevent the meter from revolving when no current is flowing, the hub of the armature disc is provided with a small piece of iron wire which is so bent that it is arrested when passing the brake magnet, as long as the current in the main coils is below 1 per cent of its maximum value. The instrument is described in great de-

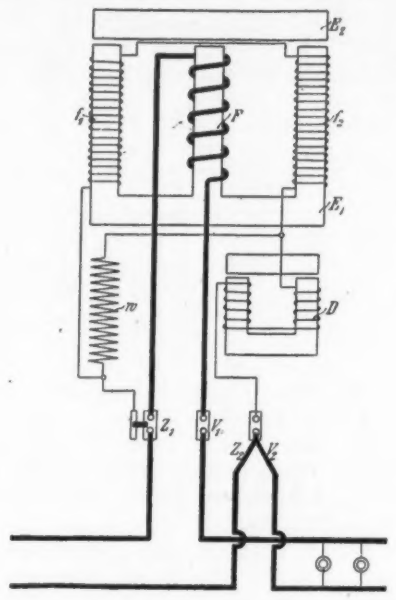


FIG. 5.—DIAGRAM OF METER CONNECTIONS.

tail. The same issue contains an illustrated description of a three-phase induction meter of the Allgem. Elek. Ges.—*Elek. Zeit.*, May 24.

Dead Points of a Galvanometer Needle for Transient Currents.—Russell.—An abstract of a British Phys. Soc'y paper. When many types of needle galvanometer are connected with a condenser and a battery in the ordinary manner by a charge and discharge key the following phenomena can easily be observed. When the needle is initially at right angles to the axis of the galvanometer coil, and the spot of light is in the center, *X*, of the scale, the throws on charge and discharge are equal. If the controlling magnet be turned through a small angle, or if the suspending fibre be twisted slightly so that the spot of light is not in the center of the scale initially, the throws on charge and discharge are not equal. The algebraic difference between them, however, is constant. Hence, for an initial position, P_1, of the spot of light there is no throw on charge, and similarly for another initial position, P_2, there is no throw on discharge. These points the author calls the dead points. If the resistance of the charging and discharging circuits are the same, $XP_1 = XP_2$. In this case the distance, P_1P_2, varies directly as the resistance of the charging circuit, and inversely as the applied voltage. If the initial position of the spot of light be outside of P_1P_2, the throws on charge and discharge are in the same direction. The author shows that these effects can be explained with considerable accuracy by supposing that the magnetism of the needle consists of two parts, one permanent and the other proportional to the magnetizing force. Lord Rayleigh formerly showed that this supposition is sufficient to explain the permanent deflection produced by an alternating current passing through the galvanometer coil, and that a galvanometer is a very imperfect instrument for indicating whether the integral sum of the transient currents through it is zero or not; he also mentioned the limitations this imposes on Maxwell's method of comparing mutual inductances. The author finds that it is easy to arrange with a low-resistance galvanometer so that a, relatively speaking, gigantic charge can be passed through the coil without producing any throw at all. He also finds that all the galvanometers he has tested, whether needle or moving coil, will produce throws when certain transient currents pass through them, even though the integral value of these currents is zero. It also appears that the effective internal resistance of ordinary condensers is appreciable in certain cases. These results are of importance in connection with several of the customary methods of testing.—Lond. *Elec.*, May 25.

Telegraphy, Telephony and Signals.

Magnetic Detector.—At the recent soiree of the Royal Society in London, Walter exhibited a new magnetic detector for wireless telegraphy. Two small continuous-current magneto machines, with shuttle-wound armatures, are connected with their voltages in opposition, and are so adjusted that normally no current flows. The core of one armature, instead of being made of the usual laminations, is formed of a coil of iron wire, the ends of which are brought out and connected to the receiving circuit. Electric oscillations are thus passed through the core, and produce the well-known effect of increasing its permeability. Hence the winding of that armature revolves in a stronger field, and generates a higher voltage, upsetting the electrical balance of the system, and providing an external direct current which will affect a galvanometer every time an electric wave is received. The signals may be heard in a telephone receiver, as the current is only momentary, or may be taken down by a recording instrument worked through a delicate relay.—Lond. *Eng'ing,* May 11.

Directed Wireless Telegraphy.—BRAUN.—The first part of a mathematical article describing his method of sending wireless telegraph messages in a certain direction, the principle of which was described and illustrated in the Digest, December 16, 1905, p. 1041. The same issue contains a long editorial summary of the various attempts which have been made on directed wireless telegraphy.—Lond. *Elec.,* May 25.

Submarine Signalling.—MILLER.—A paper read before the London Society of Arts on submarine signalling by means of sound. —Lond. *Elec.,* May 11.

Electrophysics and Magnetism.

Variations of Resistance of Thin Metallic Films by Influence. —BOSE.—A very thin metallic film is inserted in a Wheatstone bridge arrangement, which enables one to measure the resistance of the film. This thin metallic film is placed between two insulating glass or mica plates against the outer surfaces of which thicker metallic plates are pressed which are connected with one pole of an influence machine. These two plates thereby receive an electrostatic charge of a certain sign, while the thin film in the center receives a charge of the other sign. This is applied directly by the author to electronic considerations. If, as is usually assumed, the negative electrons alone have a high mobility, it follows that when the two external plates are positively charged, the resistance of the film in the center must decrease; when negatively charged, the resistance must increase. This was in fact confirmed by the experiments of the author. This gives a direct and easy method of determining the numbers of negative electrons in metallic conductors. For platinum the author finds as an average 10^{22} electrons per c.c.—*Phys. Zeit.,* June 1.

Energy, Duration, Damping and Resistance of Condenser Sparks.—HEYDWEILLER.—The art of wireless telegraphy has given a new importance to the study of electric sparks. The present author points out the necessity for adding another term to Lord Kelvin's celebrated differential equation, which expresses energy relation in regard to the discharges of a condenser. This new term expresses the spark energy. The resulting differential equation is complicated and its integration in the words of the author must remain a pious wish; still several solutions can be obtained by making suitable suppositions in regard to the electrical constants of the circuit. The author finds that the resistance of the condenser sparks which are usually employed in wireless telegraphy is less than an ohm.—*Am. Jour. of Science,* June; from *Ann. d. Phys.,* No. 4.

BOOK REVIEWS.

FOWLER'S ELECTRICAL ENGINEERS' YEAR BOOK. Manchester, England: Scientific Publishing Company. 643 pages, 100 illustrations, numerous tables. Price, 1 shilling, sixpence.

This is the 1906 edition of Mr. Fowler's well-known pocket book for electrical engineers. The present edition has been revised and somewhat enlarged. Among the new material may be mentioned a section dealing with the design of alternators and a section treating on steam turbines and turbo-generators. Power and cost of electric distribution are matters on which additional information is given, and some notes on insulating materials used for electric machines are added. The usual Board of Trade Rules for lighting and traction, and also the new regulations for the use of electricity in mines, have been included.

ILLUSTRATED TECHNICAL DICTIONARY. In Six Languages—English, German, French, Russian, Italian and Spanish. Vol. I, Machine Details and Tools. New York: McGraw Publishing Company. 403 pages. Price, $2.00.

This is the first volume of the American edition of a series of technical dictionaries of which eleven volumes are now under preparation, the compilers being K. Deinhardt and A. Schlomann. The second volume to be issued will be on electrical subjects, and other volumes will cover steam boilers and steam engines, hydraulic machinery, hoisting and conveying machinery, small tools and machine tools, metallurgy, etc. The dictionary is on a new plan and one that appears to meet more nearly than other technical dictionaries published the numerous difficulties involved in the production of a successful technological dictionary covering a number of languages. The main feature of the dictionary consists in a classification whereby related subjects are brought together, reference to any desired subject being obtained through a general index of the terms for all languages covered, which comprises about one-half of the volume. Another admirable feature consists in the use of simple illustrations in line whereby one who refers to the dictionary can determine which one of several related entries is that which he is seeking. For example, in the present volume, if the foreign term for a certain kind of a saw is desired, or if in reading, the foreign term for a saw is encountered, the reader first refers to the index for the page number, which passes him to the section on saws. There he will find illustrations of all the various classes of saws, and thus if he wishes to find the exact foreign word for a particular kind of a saw he is guided by the illustration; or if, on the other hand, a foreign word refers to a kind of saw with which he is not acquainted, he is informed by the illustration. In the case of subjects having a number of parts, such as a steam cylinder, all of the parts of a general illustration are lettered, and instead of repeating illustrations of details in the middle column, letters corresponding to the various parts shown in the general illustration are substituted.

The pages contain three columns, with the illustrations, and references to illustrations, in the middle column. The column on the left contains the words in German, English and French and in the third column are the words in Russian, Italian and Spanish. The general index contains, of course, every term in the dictionary, alphabetically arranged, without distinction of language. The index to Russian terms is printed separately, owing to the variation of the Russian alphabet from that of the other five languages covered.

BOOKS RECEIVED.

SHAFT GOVERNORS. By W. Trinks and C. Housum. New York: D. Van Nostrand Company. 97 pages, 24 illustrations. price, 50 cents.

ELECTRIC POWER PLANTS. By Norman H. Schneider. Revised Edition. New York: Spon & Chamberlain. 274 pages, 203 illustrations. Price, $1.50.

PRACTICAL TELEPHONY. Fourth Edition. By James Bell and S. Wilson. London: S. Rentell & Company. 381 pages, 322 illustrations. Price, 3s. 6d.

THE PRACTICAL TELEPHONE HANDBOOK. Third Edition. By Joseph Poole. London: Whittaker & Co. 533 pages, 473 illustrations. Price, $2.00.

ENTWURF VON SCHALTUNGEN UND SCHALTAPPARATEN. Vol. I. By Robert Edler. Hannover: Max Janecke. 192 pages, 186 illustrations. Price, 6 marks.

MOTIVE POWER AND GEARING FOR ELECTRICAL MACHINERY. By E. Tremlett Carter. Second Edition. New York: D. Van Nostrand Company. 654 pages, 199 illustrations. Price, $3.00.

A PRACTICAL TREATISE ON THE STEAM ENGINE INDICATOR AND INDICATOR DIAGRAMS. Second Edition, Revised and Enlarged. By W. Worby Beaumont. New York: D. Van Nostrand Company. 250 pages, 128 illustrations. Price, $2.50 net.

A New Induction Watt-Hour Meter.

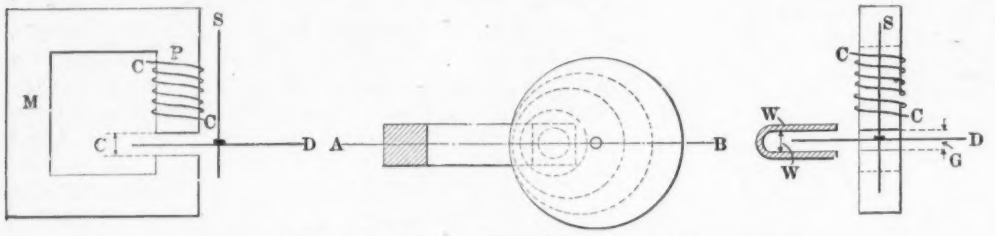
By G. Faccioli.

The subject of this article is the description and the study of a new induction watt-hour meter recently invented by Mr. William Stanley. The motor device used in this meter, although operating on the induction principle, is a decided departure from anything that has been made heretofore, and does not employ the phase-differing principle of Ferraris.

Its principle of operation may be seen from Fig. 1. *M* is an iron core provided with an air-gap, *G*. In this gap is a metal disc, *D*, mounted on a shaft, *S*; the pole, *P*, is wound with a coil, *C*. If alternating current is sent through the coil, *C*, a magnetic flux will be produced in the gap, *G*, and a system of eddy currents will be set up in the disc, *D*. The paths of these eddy currents are circles with their centers on the diameter, *AB*, as represented in Fig. 2.

The eddy currents of the disc, *D*, will set up a reaction flux which will be intense in the gap, *G*, under the pole, *P*, and naturally very weak outside of the pole, *P*, on account of the high reluctance of the magnetic circuit.

In the gap, *G*, there will be, therefore, a flux due to the resultant of the magnetomotive force of the current in the coil, *C*, and of the eddy currents in the disc. Let this resultant flux be represented by *F*. It is easily seen that with these conditions



FIGS. 1, 2 AND 3.—SKETCHES SHOWING PRINCIPLE OF OPERATION.

the disc will not rotate because the reaction of the eddy currents upon the flux, *F*, is such as to tend to compress each eddy current toward its center all along its path, and, consequently, the torques on one side of the diameter, *AB*, will be equal and opposite to the torques on the opposite side and thus cancel each other's effects. If, however, the value of the torques is artificially increased on one side of the diameter, *AB*, then the disc will rotate. In order to obtain this result, Mr. Stanley provides the apparatus with a third element, the wing or armature, *W*, which embraces the disc on one side only of the pole, *P*, as shown in Fig. 3. This wing is simply an iron leaf affording a magnetic circuit of low reluctance to the flux set up by the eddy currents on one side of the pole, *P*. Fig. 4 shows one of these wings.

As a result of this arrangement there is again a resultant flux, *F*, in the gap, *P*, due to the resultant m.m.f. of the current in the coil, *C*, and of the eddy currents of the disc, and a flux, *f*, in the gap of the wing, *W*, due to the eddy currents only and in phase with them. Evidently, the flux due to the eddy currents on the other side of the pole, *P*, is negligible.

Fig. 5 represents a disc with a section of the exciting pole and the wing in the right position. The shape of the wing is designed to give the maximum torque for the weight used.

It is interesting to note that the main flux set up by the current in the coil, *C* (Fig. 1), is not a torque factor; that is to say, this flux does not react on the eddy currents to produce rotation, but its function is simply to excite the eddy currents in the disc, the torque being caused by the reaction of these eddy currents upon the flux that they themselves have set up in the gap of the third element, *W*. In other words, the flux, *f*, of the gap in *W*, attracts the eddy currents of the disc, *D*, which will, therefore, continuously rotate from the pole, *P*, towards the wing, *W*.

The torque is proportional to the product of the eddy currents times the flux, *f*, of the gap in *W*, and since this flux, *f*, is proportional and in phase with the eddy currents producing it, the torque is proportional to the square of such eddy currents. For fixed mechanical dimensions of the motor and fixed frequency of the supplied current the eddy currents are proportional to the flux, *F*, and consequently, the torque is proportional to F^2.

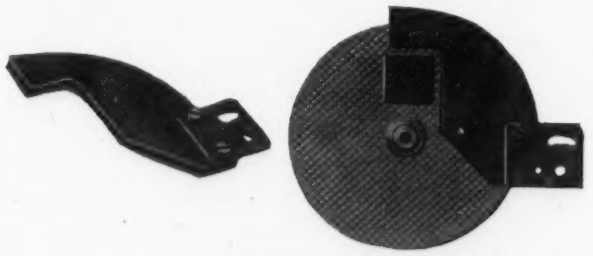
In order to measure the watt-hours properly it is necessary to have an apparatus whose torque acting upon the disc shall be proportional to $EI \cos \Theta$, where *E* and *I* are respectively the electromotive force and the current of the circuit to be measured, and Θ the angle representing their difference of phase.

At first sight it seems impossible to use the motor above described to measure electrical energy, because its torque is proportional to the square of the flux, *F*, and consequently proportional to the square of the m.m.f. of the coil, *C*. This m.m.f. can be made proportional to the voltage or to the current of the circuit to be measured, or to a combination of both, but in any case, it is impossible to reach a torque proportional to $EI \cos \Theta$. It is, therefore, necessary to automatically extract the square root of the torque produced by the m.m.f. upon the motor.

To solve this difficulty, Mr. Stanley combines two motors of the type above described in a differential system, as illustrated in Fig. 6. Fig. 7 represents the iron cores and windings of the two motors one on top of the other. Fig. 8 represents the movable part of the system consisting of two aluminum discs of identical dimensions mounted on the same staff, each disc being energized by one of the two motors represented in Fig. 6. The system is a differential system; that is to say, the torques of the upper and lower motor are in opposite direction (Fig. 6), in fact, the wing of the upper motor is on the right-hand side of its pole, tending to produce a counter-clockwise rotation of the movable system, while the wing of the lower motor is on the left-hand side, tending to rotate the movable system in a clockwise direction.

The resultant torque which will actually produce rotation of both the discs will then be the difference of the individual torques of the two motors. The value of these torques and of their resultants is easily found by referring to the diagram of connections in in Fig. 9. *A* and *B* represent two coils which are wound on the pole of the upper motor of the system. *A'* and *B'* are two coils which are wound on the pole of the lower motor of the system. *A* and *A'*, which are identical and constitute the shunt winding of the apparatus, are wound in the same direction and are connected in series across the mains of the load circuit. *B* and *B'* constitute the series winding of the apparatus; they are identical and are connected in series one with the other, and are traversed by the current of the load circuit. This current, however, flows through the coil, *B'*, in a direction opposite to that in the coil, *B*. The arrows in Fig. 9 show the direction of the currents flowing at a certain instant through the system.

To clearly understand the operation of the apparatus, consider the case of non-inductive load, and suppose for the moment that the m.m.f. of the current in the coils, *A* and *A'*, is proportional and in phase with the e.m.f., *E*, of the system, and that the m.m.f.



FIGS. 4 AND 5.—VIEWS OF WING AND DISC.

of the coils, *B* and *B'*, be proportional and in phase with the current, *I*, of the system. In this case, the fluxes of all four coils will be in phase (load power factor = 1). If the flux produced by each one of the coils, *A* and *A'*, be denoted by *a*, and *b* denotes the flux produced by each of the coils, *B* and *B'*, then the total flux of the upper motor (coils *A* and *B*) is $a + b$, while the total flux of the lower motor is $a - b$. It follows that the torque of the upper motor will be proportional to $(a + b)^2$, and that the torque of the lower motor will be proportional to $(a - b)^2$. The resultant torque of the system will be proportional to $(a + b)^2 - (a - b)^2 = 4ab$. The resultant torque will then be proportional

to the product of a and b, and since a and b are respectively proportional to the e.m.f., E, and the current, I, of the circuit, the resultant torque of the apparatus will be proportional to EI; that is to say, to the power in the circuit.

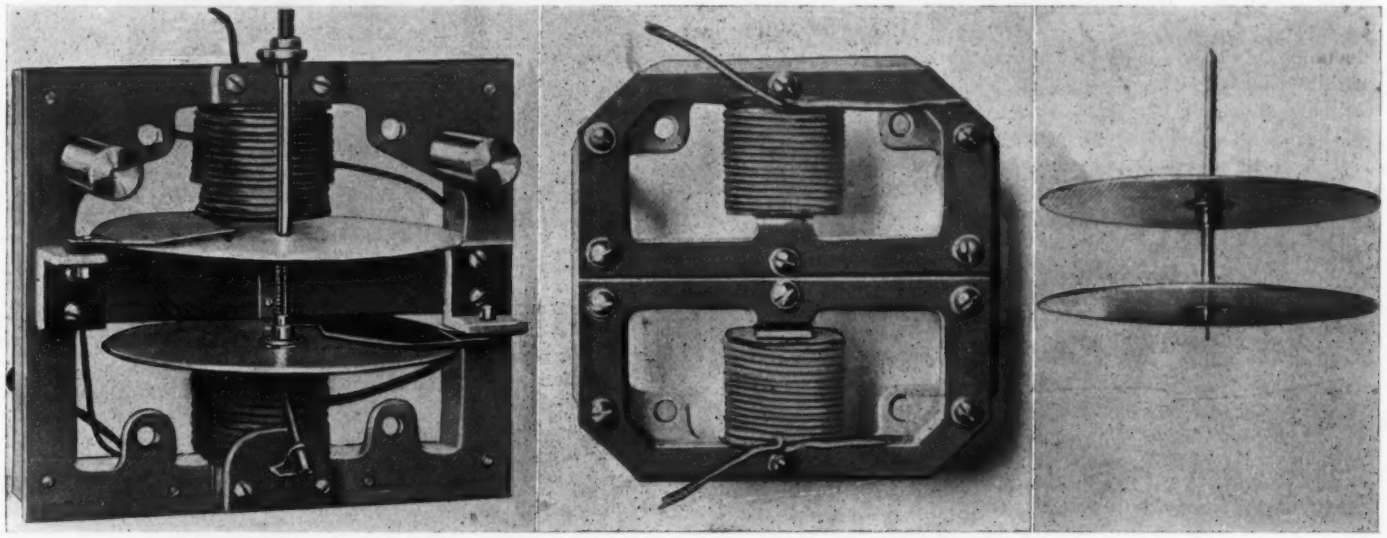
It may easily be demonstrated that the torque is proportional to the true watts of the circuit, even in the case of inductive load. Referring to Fig. 10 where the vectors, a and a', b and b', represent in magnitude and phase the fluxes produced respectively by the currents in the coils, A and A', B and B', a and a' are of the same value and direction, and are supposed to be proportional to, and in phase with, the e.m.f., E, of the circuit. Similarly, b and b' are of the same value but of opposite direction, and are proportional to and in phase with the current, I, of the circuit. If Θ is the angle formed by a and b, $cos\ \Theta$ is the power factor of the load circuit. The upper motor (energized by coils A and B) will have a resultant flux represented in magnitude and phase by c, the value of c being represented by the formula

$$c = \sqrt{(a + b\ cos\ \Theta)^2 + b^2\ sin^2\ \Theta}$$

The lower motor (energized by coils A' and B') will have a resultant flux represented in magnitude and phase by d, the value of d being given by the formula

$$d = \sqrt{(a - b\ cos\ \Theta)^2 + b^2\ sin^2\ \Theta}$$

The torques of the two motors will be respectively proportional to c^2 and d^2, and the resultant torque of the system will be proportional to $c^2 - d^2 = 4\ ab\ cos\ \Theta$. In other words, the torque of the apparatus is proportional to the true watts of the circuit for a load at any power factor.



FIGS. 6, 7 AND 8.—COMPONENT PARTS OF MOTOR.

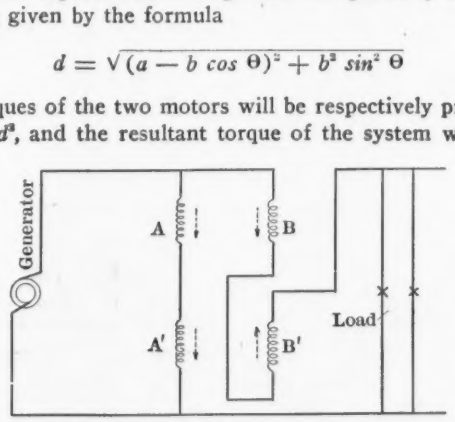


FIG. 9.—DIAGRAM SHOWING METHOD OF PRODUCING TORQUE.

It has thus far been assumed that the m.m.f's of the shunt coils, A and A', are in phase with and proportional to the e.m.f., E, of the circuit, and that the m.m.f's of the series coils, B and B', are in phase with and proportional to the current, I, of the circuit. It is to be noted, however, that the coils, A and A', constituting the shunt winding of the meter, are wound with a large number of turns, and, therefore, the shunt current flowing through such coils and their m.m.f's will lag considerably behind the e.m.f., E, of the circuit on account of the high self-induction of the coils, A and A'. On the other hand, the m.m.f. of the coils, B and B', are in phase with and proportional to the load current, I, of the circuit. If the simple connections of Fig. 9 were used the resultant torque of the meter would be proportional to the e.m.f., E, of the circuit, but lagging behind it; b would be proportional to and in phase with the current, I, of the circuit, and the angle, Θ, between a and b, would be different from the phase displacement between the e.m.f., E, and the current, I, of the circuit. It is obvious that in order to obtain a torque proportional to the true watts it is necessary that the angle between a and b be equal to the angle between the electromotive force, E, and the current, I, a and b being respectively proportional to E and I. To reach this result it is then necessary to lag the m.m.f. b, behind the current, I, by the same angle by which the magneto-motive force, a, lags behind the electromotive force, E. In other words, the current, i, actually flowing through the series coils, B and B', of the meter must be proportional to the load current, I, of the circuit and lag behind it by the same angle by which the current flowing through the coils, A and A', lags behind the electromotive force, E. To shift b behind I by the required angle the arrangement shown in Fig. 11 is used.

The series coils, B and B', are shunted by a non-inductive resistance, R, so that the total load current, I, will be split in two, a part, i, flowing through the meter coils and originating the m.m.f., b, and the part, j, flowing through the non-inductive resistance, R. By conveniently proportioning the value of R for a given resistance and inductance of the meter coils, B and B', it is possible to lag i behind I by the required angle.

The shunt resistance, R, must be smaller in value the larger

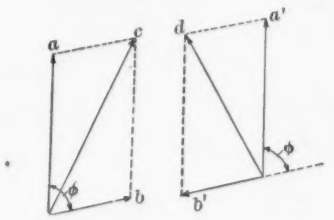


FIG. 10.—COMBINATION OF FLUXES.

is the required angle, and it is evident that the smaller the resistance, R, the larger will be the amount of current shunted away from the meter windings. The result is that, for certain requirements the angle should be kept as small as possible, but on the other hand, the following considerations of the performance of the meter suggest the use of a considerable phase displacement between the m.m.f's, a and b, and the e.m.f. and load current of the circuit. We have seen that for given mechanical dimensions of the apparatus and for a given frequency the torque of each motor is proportional to the square of the magnetizing flux of such motor, and the resultant torque of the instrument is proportional to the power in the circuit. If, however, the frequency of the circuit is changed, the same value of the energizing flux,

F, will produce in the disc eddy currents whose value increases with the frequency of *F*, consequently, the torque of each individual motor which is proportional to the square of the eddy currents will increase with the applied frequency, and almost proportionally to the square of such frequency. Evidently, the resultant torque of the instrument will follow the same law as the torque of each individual motor.

To compensate the meter for variations of frequency it is necessary that the flux, *F*, depend not only on the voltage, *E*, and the current, *I*, of the system, but on its frequency also; that is to say, for the same amount of power in the circuit the flux, *F*, must decrease when the frequency increases, and increase when the frequency decreases. This result can be obtained by controlling the shunt and series currents of the meter by the inductance of the windings rather than by their resistance, so that within a certain limited range of frequency the meter readings will be practically correct.

The value of the shunt current flowing through the coils, *A* and *A'*, is inversely proportional to the impedance of the circuit, and will, therefore, decrease with the increase of the applied frequency, and this shunt current will lag in phase behind the e.m.f., *E*, of the circuit by an angle whose tangent is equal to the ratio of the reactance to the resistance. Similarly, the current flowing through the series coils, *B* and *B'*, of the meter, which are shunted by a non-inductive resistance, *R*, depends upon the frequency of the system, and its variations in phase and value are nearly identical with those of the shunt current of the meter.

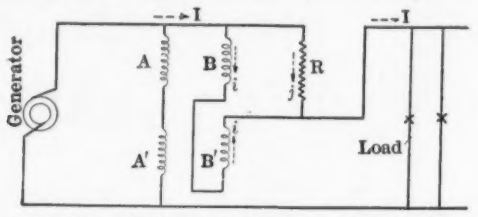


FIG. 11.—DIAGRAM SHOWING METHOD OF LAGGING THE SERVICE CURRENT.

It is to be noted that the shunt circuit of the apparatus, although superimposed on the poles of the series circuit, is absolutely independent of it. In fact, the fluxes produced by the current in the shunt coils, *A* and *A'*, thread through the coils, *B* and *B'*, in opposite directions and similarly, the fluxes produced by the current in the series coils, *B* and *B'*, thread through the coils, *A* and *A'*, in opposite directions; consequently, the mutual induction of the two circuits is zero. Similarly, the whole flux of the upper motor is independent of the flux of the lower motor; they are carried by separate magnetic circuits and work on separate discs, making impossible any interaction between the fluxes of the two motors.

The mechanical construction of the apparatus is extremely simple. The upper and lower motor are identical and each motor consists of a laminated iron core provided with one gap only, this gap being energized by two superimposed coils. The element which plays the most important part in the operation of the apparatus, the wing, is also the simplest in mechanical construction. The torque of each motor depends, naturally, upon the area of the disc embraced by the wing and can be easily varied by changing the position of the wing. Each wing is, therefore, adjustable in position, and thereby the apparatus can be easily and perfectly balanced. To complete the apparatus it is only necessary to provide one of its discs with permanent brake magnets and connect the staff to a train in the usual manner. See Fig. 12.

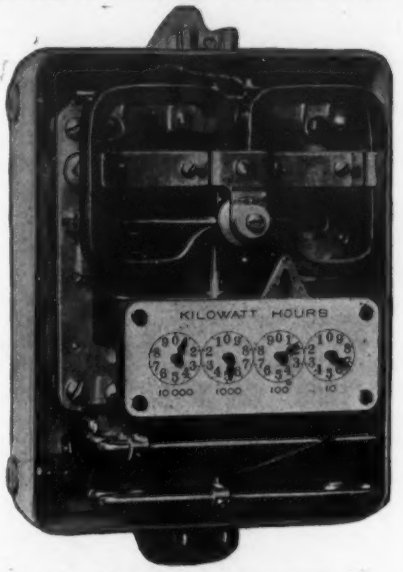


FIG. 12.—WATT-HOUR METER.

Many meters of this type have been built and experimented upon and the results of the tests are most excellent and corroborate the theory here given. The load curve and the voltage curve of the meter at different power factors and frequency are almost perfect.

Koerting Four-Stroke Cycle Gas Engine.

Fig. 2 herewith shows the single-cylinder Koerting four-stroke cycle gas engine which is built in this country by the De La Vergne Machine Company, of New York City, in sizes ranging from 75 to 350 hp. The engine, which is of massive and stiff construction, is fitted with open-end, trunk-type pistons, by means of which cross heads and guides are obviated and the number of working parts reduced. The cylinder is water-cooled and is securely held by the main engine frame casting. The crank end is packed against the cooling water in the jacket by a small stuffing box which allows longitudinal expansion. The joint at the head end of the water jacket is made by a thin gasket inserted between the flange of the cylinder and the main frame casting against which it is securely held by the main cylinder head studs. The double-seated mixing valve, to which this engine owes its popularity, is operated automatically by the incoming complements of gas and air. The exhaust valve being closed when the engine passes dead center, the piston starting on its forward stroke tends to form a vacuum within the cylinder. A slight reduction in pressure, however, suffices to open the mixing valve and admit air by one of its seats and gas by

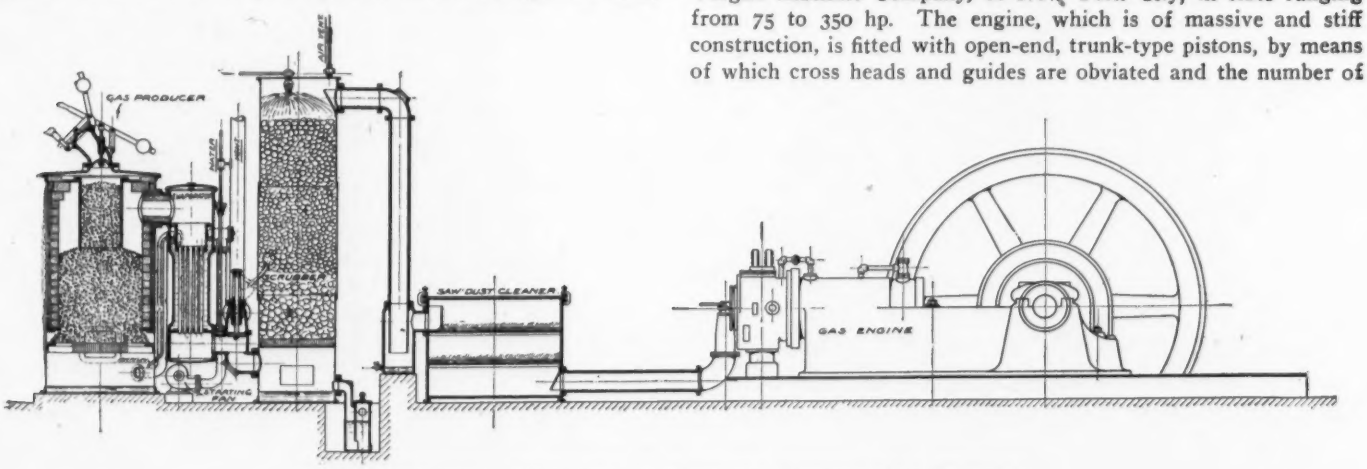


FIG. 1.—SECTIONAL ELEVATION OF KOERTING SUCTION GAS PRODUCER.

the other. Gas is supplied to the mixing valve in proper proportions to insure perfect combustion by means of an outside set valve.

The governor does not regulate the speed of the engine by varying the proportions of gas and air, but by measuring out the amount of mixture required by the load on the engine. It is very sensitive and operates a butterfly valve. Ignition of the mixture is effected by an oscillating magneto and the plugs carrying the rods and contact points are readily removable. The time of ignition can be varied at pleasure while the engine is running. Compressed air stored in a receiver is used to start the engine, the air pressure being maintained by an auxiliary compressor driven by the engine itself. The valves are operated by push rods from cams on a shaft driven by skew gear from the crank shaft. Three brackets rigidly support the boxes of this shaft, the spur gear which runs the governor being situated near one of the brackets. The exhaust valve is located a little above the bottom of the cylinders so as to prevent back fire due to oil residuum passing from the cylinder into the valve. A relief valve is provided on the bottom of the cylinder for blowing out any oil residuum which might gather.

The Koerting suction gas producer is shown in Fig. 1. This

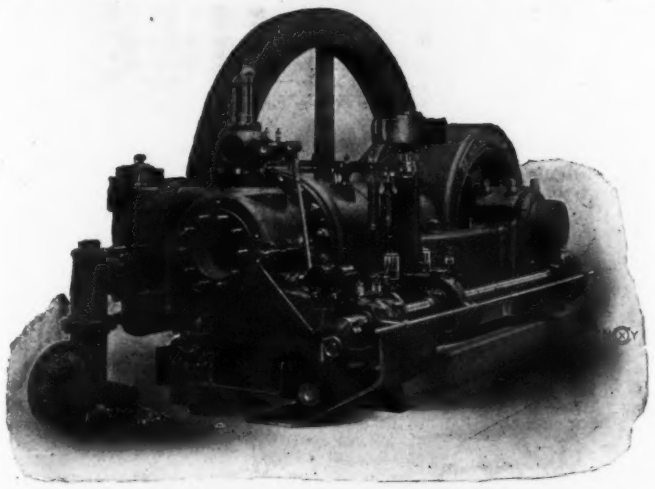


FIG. 2.—KOERTING FOUR-STROKE CYCLE GAS ENGINE.

consists essentially of a generator, an evaporator, a scrubber or purifier and a sawdust purifier. The construction is evident from the engraving. The producer is started by building a fire on the grate of the generator and charging it with coke or coal. Air is forced through the generator by means of a small hand blower until the charge is well ignited, a vent valve permitting the smoke to escape up the chimney. The fuel having become incandescent up to the bottom of the hopper, the chimney passage is closed and the gas tested. If it burns with a reddish-blue flame not easily extinguished, the valve leading to the mixing valve may be opened and the engine started. As soon as the engine has made a few revolutions it will pump its own gas, and unless the exhaust fan is required to force the gas through an outside system it can be stopped. Simplicity and low first cost are among the numerous advantages claimed for suction gas producers. The De La Vergne Machine Company has at its works a 75-hp engine in continuous operation in connection with a suction gas producer developing, it is claimed, one brake horsepower with less than one pound of coal.

Electrification Plans of the Erie Railroad.

The contract for the electrification of the Rochester division of the Erie Railroad, between Mt. Morris and Rochester, N. Y., was awarded last week to Westinghouse, Church, Kerr & Co. This section is about 35 miles in length and extends south from Rochester to the junction of the Rochester branch with the Delaware, Lackawanna & Western Railroad. Work has already been commenced.

The next section of the Erie Railroad Co.'s system in western New York to be equipped is from Avon to Corning, a distance of about 70 miles. The single-phase system has been adopted and the operating voltage will probably be the same as that adopted by the New York, New Haven & Hartford Railroad, or 11,000 volts. In this case only one sub-station, located about the middle of the line, will be required. Power will probably be taken from the transmission lines of the Ontario Power Company, which cross the tracks on that part of the Erie Railroad to be electrified.

The cars to be used will be very similar to the standard Erie Railroad passenger coach, but slightly shorter and slightly heavier. It is proposed to run the cars in trains with the multiple-unit system and part of each train will be composed of trailers. Later locomotives may be used on some trains.

The Electrical Commission of the Erie Railroad has now practically completed its work of preparing estimates upon the cost of electrification of the Greenwood Lake and other suburban divisions of the Erie Railroad near New York by the various systems in most common use, and these estimates will be considered by the Executive Committee at an early date.

A New Insulator Pin.

The accompanying illustration shows the type of insulator pin used on the overhead circuits of the Long Island Railroad Company. The pin, which is the invention of Mr. W. N. Smith, of Westinghouse, Church, Kerr & Co., who has applied for a patent on the device, will be placed on the market under the name of the "Smith-Grip Insulator Pin." More than 8,000 of these pins are used on the transmission lines of the Long Island Railroad, carrying 250-cir.-mil cables in spans averaging 150 ft. in length, and no failures have been reported after a year of service. A dozen or more standard sizes of an improved design of the pin are being worked up, to fit various sizes of cross arms and pole tops and to carry insulators of various sizes. While designed particularly for use with wooden cross arms, the pin can be

NEW INSULATOR PIN.

readily adapted to steel cross arms or any special pin support, and also used in heavy catenary trolley construction.

The claims made for the pin are as follows: It does away with the necessity of boring holes in the cross arms, thereby conserving the whole strength of the arm and lengthening its life; the metal composing it is distributed in the most effective manner possible, and its cross-section is greatest next to the arm where the greatest resistance to bending is required; and finally the shrinkage of the arm can more effectively be taken care of by the U-bolt and strap than by any of the other forms of pin fastening in common use, as there is no tendency to distort the bolt, and consequently there is no possibility of the pin standing crooked upon the arm after the shrinkage has been taken up. Furthermore, it is practically indestructible, and instead of being one of the weakest factors in line construction it will be the strongest, as the cross arm will not be weakened by holes.

Convention Exhibits.

Considerable space was devoted in these pages last week to notes of the exhibits, etc., at the Atlantic City Convention of the N. E. L. A. Further data are given below:

The Samson Cordage Works, of Boston, was represented by Mr. F. J. Coakley.

Mr. Arthur Bosley, of the Electrical Material Company, of Baltimore, attended the convention.

Messrs. Walker & Kepler, of Philadelphia, were represented by Mr. H. G. Walker and Mr. Fred Dolbier.

The Sterling Varnish Company, of Pittsburg, was represented by Mr. Alvin S. King, Eastern manager.

The Frank H. Stewart Electrical Company, of Philadelphia, was represented by Mr. Frank H. Stewart, president, who had some samples with him.

Harvey Hubbell, Inc., of Bridgeport, Conn., manufacturer of the well-known Hubbell shades, reflectors, etc., was represented by its New York agent.

The Franklin Electrical Manufacturing Company, of Hartford, Conn., was represented by Mr. Henry A. Truitt, who also represented the Imperial Electric Company, of Philadelphia.

The Southern Power Company, of Charlottetown, N. C., are building a new plant on the Catawba River. Mr. F. D. Sampson, superintendent, attended the convention to study apparatus and secure data.

The Safety Insulated Wire & Cable Company, of New York and Bayonne, N. J., was represented by Mr. A. P. Eckert, sales manager, and Mr. James Ferguson, superintendent. It had an exhibit with the Electric Service Supplies Company. Mr. Eckert handed out to his friends a very attractive little note book.

The Electrical Trades Exposition Company, of Chicago, was ably represented at the convention by Mr. Henry F. Frosch, who made many friends and did good work on behalf of the second annual electrical show to be held in Chicago next January under the auspices of his company. A large number of applications for space have already been filed by the Atlantic City N. E. L. A. contingent.

Metropolitan Engineering Company, of New York, showed its new sign made of stamped steel with letters raised from the background finished in baked glazed enamel. This exhibit attracted much attention owing to the fact that these signs could be so readily read from any part of the pier. The company was represented by Mr. George Howe, general manager; Mr. Benjamin Wall, assistant general manager, and Mr. W. R. McDaniel, manager of sales.

The Baseball Game.—One of the entertainments provided at the N. E. L. A. Convention was a baseball game between the representatives of the East and the West. Captain Vaughan (Schenectady) and Captain Gilchrist (Chicago) were successful in securing two very evenly matched teams, who played a vigorous and exciting game, which resulted in a victory for the East, the score being 10 to 8. Umpire Wakeman was very successful in keeping the honors easy between the two teams, but escaped personal injury from the spectators.

The Rolling Chair Boardwalk Parade received proper zest from the happy thought of "The Silver King," Mr. W. P. Casper, of the Electric Service Supplies Company, Philadelphia, who at very short notice had printed a full batch of the touchingly sentimental ballad, "Why Don't You Try?" Mr. Casper, with his ostentatious modesty, disdained claiming the credit of the idea, which, he says, originated with the well-known general manager of the Union Electric Company, of Dubuque, Iowa, Mr. L. D. Mathes. That gentleman on being accused of the offence gracefully acknowledged his crime.

An Interesting Group was taken at the "Hylo" exhibit of four of the "Nestors" of the convention. The photograph is reproduced herewith. It is an excellent and faithful piece of work. On the left of the engraving is President G. R. Stetson, of the New Bedford Gas & Edison Company. Next to him is President A. C. Dunham, of the Hartford Electric Light Company. In the center is Mr. A. J. De Camp, manager of the Philadelphia Electric Company, and to the extreme right is Mr. Phelps, of the Hylo Company, between whom and Mr. Stetson a remarkable resemblance exists, much to the confusion of people who do not notice faces very closely.

New York Central Locomotive at Atlantic City.—One of the 100-ton electric locomotives which the General Electric Company and the American Locomotive Company are furnishing for the electrification of the New York Central lines in New York City arrived in Atlantic City June 8 from Schenectady, N. Y. During the attendance this month at various electrical and railroad conventions prominent officials from all parts of the country will have an opportunity to inspect the locomotive. Its capacity under ordinary working conditions is 2,200 hp, and it is said to be able to develop a speed of 80 miles an hour when in regular operation. It is the most powerful electric locomotive in the world. The locomotive is the same type as the famous "6000" which has so many times distanced its steam competitor while working out on the test track on the New York Central road near Schenectady, but bears on its side the number 3404 and the inscription "New York Central Lines." The locomotive is attracting much attention at the Pennsylvania side track where it is in charge of representatives of the two companies which have been co-operating in its manufacture.

The H. W. Johns-Manville Company was well represented with a complete line of "Noark" National Electrical Code stand-

A GROUP OF OLD-TIMERS.

ard enclosed fuses and fittings. This exhibit deserves special mention, on account of the number of new devices shown of the National Electrical Code standard type, which included several forms of service and subway boxes for 250 and 600-volt circuits. Several service switch boxes were shown, fitted complete with inlet and outlet attachments as required by the National Board of Underwriters. A complete line of "Noark" fuses and cut-outs of the National Electrical Code standard type for circuits of 250 and 600 volts were shown, as well as high-tension cut-outs and fuses for circuits of 10,000 volts and less. Another feature which attracted considerable attention was a line of high-tension porcelain insulators for transmission lines of 80,000 volts and less, and several special forms of giant strain insulators for circuits of 10,000 volts and less. The construction of the latter is such that all parts under strain are insulated with heavy sheet mica, and the entire exterior covered with moulded mica insulation, thus affording the greatest possible degree of surface insulation. Another product of the company is "Transite" asbestos fireproof doors for sub-station work and other similar purposes demanding a material combining insulating and fire-proof qualities which are necessary for the protection of property and attendants. "Niagrite" fire-proof cable insulation for insulating cables located in power houses, sub-stations and manholes was shown and is coming into general use, as this material effectually prevents short-circuits under these conditions. The company distributed a superb match safe and ash tray souvenir designed in the form of a "Noark" National Electrical Code standard enclosed fuse plug made of porcelain and bronze. The following representatives were present: Mr. J. W. Perry, manager electrical department, New York; Mr. C. G. Meek, of the New York office; Mr. C. N. Manfred, manager advertising department, New York; Mr. D. T. Dickson and Mr. H. M. Voorhes, of the Philadelphia office; Mr. A. D. Newton, of the Boston office; Mr. E. B. Hatch, president, and Mr. R. S. Cole, electrical engineer of the Johns-Pratt Company.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Although there was some quietness in wholesale and jobbing lines, business was more active than is usual at this season of the year and fall orders for dry goods and wearing apparel were of good volume. The warm weather has stimulated business in retail; and in the staple industries, with few exceptions, there was activity. Reports of grain crops become more irregular as the season advances, but on the whole the situation is equal to that of a year ago. The return flow of money from the country is large and easier rates are a feature. Railway earnings continue very heavy, the increase for May being 14 per cent on roads operating outside the anthracite coal fields. In the iron and steel market steel-making irons are scarce and firm and in good demand. The railroads are the heaviest buyers of structural material, the demand for bridge work being marked. Building operations in the City of New York, as well as in some of the other large cities, are being pushed with vigor. Dealers in building materials report good business, especially those who handle second-hand material. The high cost of building material generally turns the attention of builders to available second-hand stuff. In the copper market there was a good demand from domestic and foreign consumers of Lake and electrolytic. It is stated that an electrical engineering corporation bought 5,000,000 lb. of electrolytic for September delivery at 18½c. September Lake is in large request, and prices are firm at 18⅞ to 19c. to the larger domestic consumers. Casting copper is in fair supply for near-by delivery at 18¼c., 18½c. and 18⅝c. Liberal exports of copper are reported, and the outward movement so far this month is about 4,500 tons. The total exports during June last year were 22,000 tons; for 1904, 16,200, and for 1903, 8600 tons. *Bradstreet's* reports 162 business failures during the week ending June 7, against 127 the previous week and 194 in the corresponding week of last year.

SLIDING SCALE LAW.—The Governor of Massachusetts has signed the "sliding scale" law as applied to the price of gas in the city of Boston. The gist of it lies in these sections of the measure: Section 1. From and after the thirtieth day of June in the year nineteen hundred and six, the standard price to be charged by the Boston Consolidated Gas Company for gas supplied to its patrons shall be ninety cents per one thousand cubic feet of gas, which price shall not thereafter be increased except as hereinafter provided. From and after the said date the standard rate of dividends to be paid by said company to its stockholders shall be seven per centum per annum on the par value of its capital stock, which rate shall not hereafter be increased except as hereinafter provided. Section 2. If during any year ending on the thirtieth day of June the maximum net price per thousand cubic feet charged by the company has been less than the standard price, the company may during the following year declare and pay dividends exceeding the standard rate in the ratio of one-fifth of one per centum for every one cent of reduction of said maximum net price below the standard price. Governor Guild says: "The position of the Gas and Electric Light Commission is and has been that while it could not officially urge the sliding scale as a panacea for all gas difficulties, it has not, as has been alleged in some quarters, urged a veto of the bill, nor does it regard the measure as dangerous. The bill provides for the automatic method of reduction in the price of gas, but it does not remove the gas companies from State supervision in regard to the enforced publicity of accounts, prohibition of stock-watering and other matters. It substitutes the sliding scale for a limited period in lieu of the present method of attempts at reduction in price of appeals, hearings and rulings."

TROLLEY POWER PLANT EQUIPMENT.—The Cincinnati, Milford & Loveland Traction Company, of Cincinnati, the extensions of whose present line beyond the original ten-mile run between Cincinnati and Milford, were undertaken early last fall, have been rapidly nearing completion. The company, which is backed by local Cincinnati capital exclusively, had, up to the undertaking of these extensions, purchased its power from the outside. Upon the decision of the company to extend its system from Milford to Blanchester, a distance of 21 miles, it became necessary to consider the installation of a power outfit of its own. As a result a complete equipment of Allis-Chalmers power and electrical machinery was purchased and is now being installed, preparatory to the opening up of the new section. The power plant, when completed, will consist of two Allis-Chalmers horizontal cross-compound heavy-duty engines, 16 in. and 24 in. by 42 in. for direct connection to two Allis-Chalmers "Bullock" type 500-kw generators, 25 cycles, three-phase, 400 volts. In addition to engines and generators, the equipment will include two 22½-kw belted exciters, two 400-kw, 25-cycle rotary converters and miscellaneous auxiliary apparatus.

THE LACKAWANNA STEEL COMPANY, of West Seneca, N. Y., which recently decided to operate the greater part of its mills by electricity and contracted for electric power with the Ontario power transmission plant at Niagara Falls, is now installing the electrical machinery in its power house at West Seneca. This machinery will include seven 1,500-hp transformers and a number of motor-generator sets, which will transmit the power and make it available in the mills. These electrical improvements to the steel plant will involve the expenditure of several hundred thousand dollars, and when completed will add considerably to the operative efficiency and the producing capacity of the works. All of the electrical machinery will be furnished by the Westinghouse Electric & Manufacturing Company, of Pittsburg.

NEW TURBO PLANT FOR WILMINGTON.—A company has recently been organized known as the Delmarvia Construction Company for building an entire new power plant and distribution system for serving residents of Wilmington, Del. This undertaking, it is understood, is being financed by Baltimore interests. A new plant is now under construction and is designed entirely for steam turbines. Two 500-kw Westinghouse-Parsons units will be installed at the present time, with engine and motor-driven exciter units. The plant will furnish power to an alternating-current distribution system at a frequency of 60 cycles.

WESTINGHOUSE FOUNDRIES.—Application for a charter has been made to the Pennsylvania State authorities by the Westinghouse Consolidated Foundries Company, of Pittsburg, Pa. The object is for the various Westinghouse Companies, which now have foundries at Pittsburg, Allegheny City, Cleveland and Attica, N. Y., to have all their castings made in one factory, which is located at Trafford City, near Pittsburg. This plan is to assure greater economy and uniformity in the making of foundry products.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards in the following places: Lansford, N. D.; Willow City, N. D.; Beaumont, Tex.; Page, N. D.; Colton, S. D.; Osawatomie, Kan.; Carter, Wis.; Chicago, Ill.; Galias, Me.; Sutton West, Ont., Can.; Bedford, Ind.; Grimes, Iowa; Ames, Iowa; Larrabee, Iowa; Ludlow, Ill.; Dieterick, Ill.; Streator, Ill.; Hoople, N. D.; Ashland, Mo.

THE STANDARD OIL COMPANY has ordered two "Hornsby-Akroyd" oil engines of 25 hp each, which will be shipped to Chinkiang, China, and used for pumping purposes. These engines are supplied by the De La Vergne Machine Company, of New York, which states that the use of oil engines has increased enormously in the past few years, there being now over 14,000 oil engines of the "Hornsby-Akroyd" make alone in operation.

CATALOGUES AND PRICE LISTS.—The files of the United States Signal Office at San Francisco were destroyed during the recent disaster there, and Capt. L. D. Wildman would be glad to receive catalogues and price lists from manufacturers of electrical goods.

ALLIS-CHALMERS INDUCTION MOTORS FOR ALASKA.—The Tenana Electric Company, of Fairbanks, Alaska, has recently concluded the purchase of Allis-Chalmers induction motors as follows: One 10-hp, one 15-hp, two 20-hp.

CHICAGO TELEPHONE.—The Chicago Telephone Company reports a gain of 2,388 telephones in city and country for the month of May. The total now in use is 155,613.

AUGUSTA, GA., OFFICE BUILDING.—The Augusta-Aiken Railway & Electric Company will erect a ten-story office building in Augusta, Ga., at a cost of $250,000.

EQUIPMENT OF THE DAN RIVER POWER COMPANY.—In the cotton industry the rapidly increasing demand for electrical equipments is especially noticeable, one illustration being a recent order from the Dan River Power & Manufacturing Company, Danville, Va., for its new plant, placed with the Baltimore office of the Westinghouse Electric & Manufacturing Company. The contract is practically a duplicate of the present installation, which has been in operation about eighteen months. The new plant when completed will be one of the best electrical installations for cotton mill work in the country. The mills are designed by the well-known firm of Lockwood, Green & Company, of Boston, and have the latest type cotton mill machinery driven by Westinghouse induction motors. The power plant is on the Dan River, about a mile distant from the mills, and will contain when completed three 750-kw and three 500-kw alternating current, revolving field generators of the water wheel type, with two 125-kw direct-current exciters and complete switchboard equipment. The recent order for new apparatus includes one 750-kw revolving field, 6,600 volt, 25 cycle, two-phase water wheel generator; two 500-kw generators with the same characteristics; switchboard equipment, bank of three 600-kw, oil insulated, water cooled transformers complete with oil controlling switch; low-tension switchboard and twenty-four 440 volt, three-phase induction motors, which will be used for operating the different machinery in the cotton mills. The sizes of the motors are as follows: Fourteen 100-hp, five 150-hp, two 50-hp, two 40-hp and one 75-hp.

APPARATUS FOR JAPANESE STATION.—The Tokio Electric Light Company, which has under construction the largest water power station in Japan, in carrying out its extensive plans, has placed large orders with an American manufacturer for miscellaneous electrical apparatus. The main power station of this company is located about twenty-five miles from Tokio on the Tamagawa River, and high-voltage electrical transmission lines bring the power there generated to a sub-station just on the outskirts of the Japanese capital. With the exception of the water wheels and generators, which are of German manufacture, all the main station apparatus was ordered some time ago from the General Electric Company, of New York. At the sub-station the voltage is reduced by transformers and distributed underground to various smaller stations within the city, and the Tokio Electric Light Company has just ordered all the additional apparatus for this purpose from the same company. This order will include the shipment of fifty-five 250 kilowatt transformers and seventy-eight single-phase potential regulators, as well as switchboards and auxiliary apparatus. As electricity is used for both lighting and power, the potential regulators provide a means for keeping the voltage constant at the lamps so that their light will be perfectly steady and uniform.

EDISON ON COBALT.—The Asheville *Citizen* publishes an interview with Thomas A. Edison, who says that he has made discoveries of cobalt in North Carolina that will revolutionize the electrical world. He has been in this State some time prospecting for cobalt. He says: "There is a vein of cobalt running from a point just east of Nashville, Tenn., into this State. I have found cobalt in Lincoln, Gaston, Shelby and Jackson Counties. I made assays of the mineral in many places and I found the quality to be just what I was looking for. The electric vehicles have been under a great handicap because of the heavy storage batteries we have been forced to put into them. When I can equip an automobile with the cobalt system the storage battery weight will be one-half, and when the price is reduced so as to place electrics within the reach of everybody the horse will be a thing of the past. I have left a force of men in four counties in this State where I found cobalt, and they will make a thorough investigation. I may possibly return later in the summer. Most of the cobalt now known to the world is found in France and Australia."

ALLIS-CHALMERS ENGINE SALES.—A few of the more important orders for reciprocating engines reported by the Allis-Chalmers Company, Milwaukee, for the past week are the following: International Paper Company, of New York City; four 22-in. by 42-in. Reynolds Reliance Corliss engines; the Republic Iron & Steel Company, Thomas, Ala., four 44-in. by 84-in. and 84-in. by 60-in. cross-compound, disconnected type, vertical blowing engines; the Waterbury Rolling Mills, Inc., Waterbury, Conn., one 22-in. by 48-in. Reynolds heavy-duty Corliss engine; Rockdale Improvement Company, Rockdale, Tex., one 14-in. by 30-in. Reynolds Reliance Corliss engine; Winona Copper Company, Houghton, Mich., one 16-in. and 30-in. by 36-in. Reynolds heavy-duty, cross-compound Corliss engine, one 250-kw Allis-Chalmers generator and one 15-kw exciter. The engines for these orders will be built at the West Allis, Milwaukee, engine shops and the electrical apparatus at the company's electrical works, Cincinnati.

THE RAMSEY ENGINE COMPANY, with offices in the Bullitt Building, Philadelphia, has been formed for the purpose of exploiting the Ramsey crank mechanism, which is a device applicable to all single-acting engines. A number of advantages are claimed for this device, and it is stated that in a series of tests made under the supervision of the University of Pennsylvania on a vertical engine having a 9-in. cylinder and 7-in. crank, a total efficiency of no less than 25.9 per cent was obtained. The officers of the company are: President, Robert H. Ramsey, who is the inventor of the Ramsey crank mechanism; vice-president and general manager, Russell H. Ramsey; secretary and treasurer, R. Howard Eisenbrey. Mr. Russell H. Ramsey and Mr. Eisenbrey were formerly connected with the Harrison Safety Boiler Works, of Philadelphia. It is understood that the new company will not manufacture engines, but that it will issue license rights to engine manufacturers.

RUBBER.—The world's supply of rubber is now only a little less than 60,000 tons annually. The United States takes about one-half of the total output. Ten years ago this country, says the New York *Sun*, imported about 37,000,000 pounds, valued at $16,600,000; last year 67,000,000 pounds, valued at $49,900,000. Ten years ago rubber was worth about 45 cents a pound; to-day it brings about 75 cents a pound. South America and Africa are the principal sources of supply although an appreciable quantity is obtained from other lands. Within recent years a new and ever-increasing use for it has appeared in the demand for rubber tires for vehicles, notably automobiles. As yet cultivated rubber is a comparatively small factor in the total supply, and it is probable that for many years the world must depend mainly upon the crude methods of the natives of the rubber districts. Railway extension in Africa and South America will open new regions to the industry, but it is doubtful if even then supply will keep pace with the need.

THE WAGNER ELECTRIC MFG. COMPANY, of St. Louis, desires to advise the trade that the Denver territory will be handled and controlled by Hendrie & Bolthoff Manufacturing and Supply Company, located at No. 1621 Seventeenth Street, Denver. Hendrie & Bolthoff Manufacturing and Supply Company has been well and favorably known to the trade a great many years, having built up a large business in its particular fields. The Wagner Company feels particularly gratified at having made this connection in the Denver territory, and assures its customers that all inquiries will be handled in the best possible manner. The Hendrie & Bolthoff Company has given a great deal of attention to posting its salesmen and traveling men on the characteristics and operation of the Wagner product, and the forethought of the officers of the company in giving individual attention to the salesmen will be appreciated by the trade in the Denver territory.

THE ELECTRIC CABLE COMPANY, of Bridgeport, Conn., has just installed an underground conduit system for the American Railways Company at Altoona, Pa. This conduit system was laid in wooden trenches in which the wires were embedded in Voltax, the new insulating compound used by the railway companies throughout the country. The American Railways Company has found this system so effective that it has recently placed large orders with the Electric Cable Company for further work.

ORDERS FOR GENERATORS.—The following orders of recent date are reported: City of Casey, Casey, Ill., one 115-kw Allis-Chalmers type A.H. generator, one 25-kw type A.H. generator, and one 9-kw type B exciter; the Crown Cork & Seal Company, Baltimore, Md., one 200-kw type I generator; Chandler & Taylor Co., for Tuest & Bauman-Hunt Co., of Cleveland, Ohio, one 75-kw type I generator.

Financial Intelligence.

THE WEEK IN WALL STREET.—The strength of the speculative market was irregular. Prices improved on easier money and there was greater activity, though trading was professional in character. The granger stocks were strong, in spite of unfavorable crop reports, and attention was paid to prospective good annual reports by various railroads and industrial companies. Among the specialties Consolidated Gas was strong, advancing sharply on the announcement that the United States

Court has continued the injunction against the enforcement of the 80-cent gas law in New York City. A good deal of interest attached to the declaration of the initial quarterly dividend of 1¼ per cent, being the full rate of 5 per cent per annum, on the preferred stock of the Interborough-Metropolitan Company. At the same time a quarterly dividend of 2¼ per cent on the stock of the Interborough Rapid Transit Company was announced, being an increase of one-quarter per cent over the last dividend, while it was stated that this rate was adopted in order to provide fully for the 4½ per cent annual interest upon the bonds of the Interborough-Metropolitan, which were issued to acquire the Interborough Rapid Transit stock at 200 for the latter. The regular 1¾ per cent quarterly dividend was also declared upon Metropolitan Street Railway shares, this applying to both the stock which had not been exchanged for Interborough-Metropolitan securities and to the majority which was acquired by the latter company under the recent merger deal. Among the industrials there were no features of special importance apart from the renewed strength of the United States Steel stocks, which was checked, however, by unauthentic reports of a falling off in orders, while there was more or less manipulation of a bullish character in American Smelting and Amalgamated Copper. Allis-Chalmers, common, lost ⅞ point net, as did also the preferred stock, the closing quotations being 22½ and 59½, respectively. General Electric and Westinghouse both closed with net gains, the former at 172, an advance of 2¾, and the latter at 159, a gain of 1 point. American Locomotive common made a net gain of ⅛ point and preferred 2 points, the closing quotations being 70⅜ and 116, respectively. Metropolitan Street Railway closed at 113, a gain of 2 points, but both issues of Interborough-Metropolitan were down, ¾ point for common (closing price 50⅜) and ⅜ for preferred, the closing quotation of the latter being 84⅞. Brooklyn Rapid Transit closed at 84, a net advance of 1 point. Western Union's last quotation was 92¾, which is a net gain of ¼ point. On the curb Mackay common and preferred each made a net gain of 1⅛ points, the closing quotations being 75¼ and 75¾, respectively. Following are the closing quotations of June 12:

NEW YORK

	June 5	June 12		June 5	June 12
Allis-Chalmers Co.	22⅛	21⅝	General Electric	172	171⅛
Allis-Chalmers Co. pfd.	59	57	Hudson River Tel.	...	...
American Dist. Tel.	25	25	Interborough Rap. Tran.	...	...
American Locomotive	70	72¼	Mackay Cos.	75⅛	76
American Locomotive pfd.	114⅛	115	Mackay Cos pfd.	74⅜	74¾
American Tel. & Cable	90	90	Marconi Tel.	...	...
American Tel. & Tel.	138	139	Metropolitan St. Ry.	*112	112
Brooklyn Rapid Transit	84	84⅛	N. Y. & N. J. Tel.	...	...
Electric Boat	18	18	Western Union Tel.	92¾	92⅞
Electric Boat pfd	65	65	Westinghouse com.	159	158
Electric Vehicle	11	11	Westinghouse pfd.	...	...
Electric Vehicle pfd.	18	18			

BOSTON

	June 5	June 12		June 5	June 12
American Tel. & Tel.	138¾	139⅜	Mass. Elec. Ry. pfd	70¼	73⅞
Cumberland Telephone.	...	118	Mexican Telephone	3⅜	4
Edison Elec. Illum.	246	238	New England Telephone	...	134⅛
General Electric	172⅜	171½	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	20⅜	22⅛	Western Tel. & Tel. pfd.	...	...

PHILADELPHIA

	June 5	June 12		June 5	June 12
American Railways	51¼	52	Phila. Electric	7⅞	8⅜
Elec. Co. of America	11⅝	11⅝	Phila. Rapid Trans.	25	25
Elec. Storage Battery	74	73	Phila. Traction	98¾	99
Elec. Storage Battery pfd.	...	..			

CHICAGO

	June 5	June 12		June 5	June 12
Chicago City Ry.	160	174¾	National Carbon	88	89
Chicago Edison	..	149	National Carbon pfd.	117	119
Chicago Subway	...	54¼	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd	...	...
Metropolitan Elev. com.	26	28¾			

* Asked

DIVIDENDS.—The directors of J. G. White & Co. have declared a quarterly dividend of 1½ per cent on the preferred stock, payable July 2. The directors of the General Electric Company have declared the regular quarterly dividend of 2 per cent on the stock, payable July 16. The directors of the Interborough Rapid Transit Company have declared a dividend of 2¼ per cent on the stock. It is payable to voting trust certificates of record June 20, on July 2. The directors of the Boston Suburban Electric Companies have declared the regular semi-annual dividend of 75 cents per share on the preferred stock, payable July 15. The directors of the Havana Electric Railway Company have declared a quarterly dividend of 1 per cent on the preferred stock, payable July 9. Directors of the United Traction & Electric Company, of New Jersey, have declared the regular quarterly dividend of 1¼ per cent, payable July 2. The Massachusetts Lighting Company's directors have declared a regular quarterly dividend of 1¼ per cent, payable July 16. The Cincinnati Gas & Electric Company has declared a quarterly dividend of 1⅛ per cent, payable July 2. The regular dividend of 1½ per cent for the quarter has been declared on the stock of the Cincinnati Street Railway Company, payable July 2. Directors of the Mackay Companies have declared a quarterly dividend of 1 per cent on the $41,380,000 outstanding common stock and have announced an intention to put the stock on a permanent 4 per cent basis. Dividends at the rate of 2 per cent a year have been paid since January, 1905.

CONSOLIDATION IN BALTIMORE.—A meeting of the stockholders of the Consolidated Gas, Electric Light & Power Company has been called for June 20 to consider and pass on a plan of consolidation of the company with the Consolidated Gas Company. The Consolidated Gas, Electric Light & Power Company owns all except about 42,000 shares of the total of more than 107,700 shares. At the last session of the Legislature a bill was passed which permits one lighting company to lease another in the same town and conduct the business as of one company, provided the holders of a majority of the stock agree. The bill also gives lighting companies the right to manufacture and sell gas in the territories in which they operate. The Consolidated Gas, Electric Light and Power Company was formed by the consolidation of the United Electric Light & Power Company, the Baltimore and the Wenstrom Electric companies last year. At the time the company acquired a majority of the stock of the Consolidated Gas Company, and since the adjournment of the Legislature the minority stockholders of the latter have expected it to announce some plan for the consolidation. Anticipating this two committees were formed several weeks ago to secure deposits of stock and guard the interests of the minority stockholders. Mr. N. Winslow Williams is chairman of one and the Safe Deposit & Trust Company is interested in the other.

THE AMERICAN DE FOREST WIRELESS TELEGRAPH COMPANY announces that the parent company has sold its entire Pacific Coast plant and rights to a subsidiary company known as the Oriental & Occidental De Forest Wireless Telegraph Company, for $1,000,000. The transfer includes all rights on the Pacific Coast and in Nevada, extending as far north as Alaska, and taking in the Pacific Ocean, Hawaii, Guam, China and Japan, together with the right to manufacture on the Pacific Coast all instruments needed in the establishment of stations. Headquarters will be in San Francisco. Orders are said to have been issued for the establishment of new stations at Sacramento, Eureka, Santa Barbara, Stockton and Fresno, and it is the intention of the company to extend its chain of stations as far north as Alaska as soon as the work can be done and the instruments turned out.

U. S. TELEPHONE.—One of the results of the recent sale of the control of the U. S. Telephone Company to the Brailey syndicate, of Toledo, is a proposition to increase the issue of common stock from $2,000,000 to $4,000,000, and the preferred stock from $500,000 to $1,000,000. The proceeds of the sale of these securities will be used in the extension of the company's service, which have long been under contemplation. It is not the intention to extend into new territory, but in improving the territory already occupied and in making better connections with other long-distance companies. Mr. James F. Brailey, Jr., has been elected president of the U. S. Telephone Company, and with A. H. Bauer, of St. Louis, and M. C. Harvey, of Cleveland, he will act as syndicate manager and give his time to the newly acquired properties.

NEW ENGLAND TELEPHONE.—The directors of the New England Telephone & Telegraph Company have decided to increase the outstanding capital stock of the company by the issue of $3,965,500 of new stock to the stockholders at par. Each stockholder of record on June 20 will have the right to subscribe for the new stock in the proportion of one share for each seven shares held by him on that date. The right to subscribe will expire on July 18, 1906. The new stock is issued for the purpose of providing funds for extensions of the property and for the payment of the fourth series of bonds, which is due in 1907.

PHILADELPHIA COMPANY STOCK.—According to a Pittsburg dispatch, the Philadelphia Company will issue an additional $6,000,000 of common stock. The proceeds are to be used in paying for the stock of the Beaver Valley Traction Company and the Washington & Canonsburg Railway Company, both of which were purchased last year, and for the purpose of making improvements and extensions. The directors have called a special meeting of the stockholders to be held August 14, when action on the proposition will be taken.

DETROIT HOME TELEPHONE COMPANY.—A dispatch from Philadelphia states that a syndicate deal taking over a $3,000,000 bond issue of the Home Telephone Company, of Detroit, has been closed by the Commonwealth Trust Company, of St. Louis. The bonds will be listed on the St. Louis Stock Exchange.

GENERAL NEWS.

Construction News.

BESSEMER, ALA.—The Bessemer Railway, Light & Power Company is installing new machinery in its electric lighting department.

ELBA, ALA.—The Pea River Power Company has recently ordered from the Crocker-Wheeler Company, of Ampere, N. J., a 50-kw, 2,200-volt belt type alternator to be driven by water power.

MOBILE, ALA.—The Electric Lighting Company, of Mobile, has been absorbed by the Mobile Electric Company. The company is capitalized at $3,000,000. The officers are: C. E. Groesbeck, president; S. C. Shaffner, vice-president; N. P. Zech, treasurer; S. S. Rubira, secretary. The company is identified with H. M. Byllesby & Company, which recently acquired the interests of the Electric Lighting Company, of Mobile. The company proposes to do a general electric lighting business and the manufacture and sale of gas-making apparatus, etc.

PHOENIX, ARIZ.—The entire stock, franchises and property of the Phoenix Light & Fuel Company has been transferred to the Pacific Gas & Electric Company.

BERRYVILLE, ARK.—The Town Council has granted to the Kings Rivers Electric Power Company a 99-year electric light franchise.

LAKE VILLAGE, ARK.—Engineer Bell is surveying the town, preparatory to submitting to the City Council plans and specifications for water works and an electric light plant.

BOONEVILLE, ARK.—A. Robbecke, of the Robbecke Light Company, writes that bids will be received until June 15 for the construction of an electric light plant, to cost about $5,000 or $6,000. J. W. Ivey is engineer.

JONESBORO, ARK.—The Automatic Telephone Company has filed an amendment to its articles of incorporation showing an increase in the capital stock from $25,000 to $100,000. The company proposes to put in automatic telephones in Jonesboro.

LONOKE, ARK.—Bransford & Daniels, owners of the electric lighting and water plant, have placed an order with C E Rosenbloom Machinery & Company, of Little Rock, for a 200-hp Atlas Corliss engine, and an Atlas high-pressure boiler, to increase the service of the power plant.

ELSINORE, CAL.—Plans are being made for an electric lighting plant and a telephone system, which will cost about $9,000. R. J. Dunn, of Redlands, is interested.

PASADENA, CAL.—Bids will be received by Heman Dyer, City Clerk, until July 3 for the purchase of $200,000 municipal improvement bonds of which $125,000 is to be used for the construction of an electric light plant.

VALLEJO, CAL.—The Vallejo Electric Light & Power Company is making improvements to its street lighting system. An order has been placed with the General Electric Company for two constant-current transformers of 75-light capacity each, making a total of 150 lamps for the system. The cost will be about $8,000.

LOS ANGELES, CAL.—The Home telephone companies of San Pedro, Long Beach, Santa Ana, San Bernardino, Ventura, Upland, Highland, Ontario, Fullerton, Colton and Corona have been consolidated and taken over by a syndicate of Los Angeles men, headed by Col. J. M. C. Marble, president of the National Bank of California. A stock company capitalized at $10,000,000 will be organized and incorporated with headquarters in Los Angeles. A bond issue has been effected by the promoters. The system will be extended and improved.

GREELEY, COL.—H. E. Churchill has presented a proposition to the Council from D. A. Canfield to build a street railway system for the city to cost $300,000.

COLORADO SPRINGS, COL.—Theoph. Harrison and F. E. Dow are interested in the construction of a power plant at Green Mountain Falls. Cost has not yet been estimated. Sawyer & Garston, of Colorado Springs, are the engineers.

COLORADO SPRINGS, COL.—The Colorado Light & Power Company will furnish electricity for operating the Canon City & Royal Gorge Interurban Railway Company's line extending to the top of the Royal Gorge. The line is expected to be in operation by July 1.

EAST HAMPTON, CONN.—The Rhode Island Contract Eng. Company, of Providence, R. I., has the entire contract for the installation and equipment, including lines, etc., for Salmon River Power Company, at East Hampton. The probable cost is $500,000.

NEW BRITAIN, CONN.—The city has entered into a contract with the Connecticut Railway & Lighting Company to light the streets of the city for a term of three years from April 1, 1906. While the price per arc lamp is the same as before, the service is for every night and all night, instead of moonlight schedule as under the old contract.

WILMINGTON, DEL.—The Wilmington Light, Power & Telephone Company has placed an order for an additional 1,000-kw Westinghouse steam-turbo generator. This will double the original capacity of the company's new plant. The company expects to be able to furnish electricity not later than October 1.

WASHINGTON, D. C.—Bids will be received until June 26 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards, etc., Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., League Island, Pa., Annapolis, Md., Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Schedule 595—Electric cable. Schedule 596—Generating set, etc. Schedule 597—Electrical supplies, iron fencing, cypress, etc. Schedule 598.—Motor, blowers, etc. Schedule 599—Blacksmith's forges, hydraulic jacks, electrical supplies, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

WASHINGTON, D. C.—Bids will be received until June 19 by the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the Navy Yards, at Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., League Island, Pa., Annapolis, Md., Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Schedule 287—Renewing incandescent lamps, etc. Schedule 589—Copper rivets, wire rope, nickel-steel, ingot copper, sheet copper, etc. Schedule 591—Electrical supplies, copper, plain and galvanized sheet iron, etc. Schedule 592—Steel enameled conduits, steel bolts, and nuts, hydraulic jacks, rivet forges, twist drills and sheet brass, rod and sheet copper, bar iron, steel bars, etc.

ATLANTA, GA.—The Georgia Railway and Electric Company has increased its capital stock $300,000 to $1,550,000.

TALBOTTON, GA.—H. B. Kimbrough, city clerk, writes that an election will be held on June 26 to vote on issuing $10,000 bonds for the construction of an electric light plant. J. M. McCrary, of Atlanta, is engineer.

AUGUSTA, GA.—The Twin City Power Company is having detail plans and specifications prepared for power development on Savannah River, 25 miles above Augusta. A masonry dam will be placed across the river and the power transmitted electrically to Augusta. It is estimated that 10,000 hp can be delivered in Augusta. It is probable that bids will be asked for in July. Nisbet Wingfield, of Augusta, is engineer.

LEWISTON, IDAHO.—F. M. Ogle reports that a site has been selected on the Salmon River near the mouth of Crooked River, for building a power plant for supplying the mining districts and operating mills in the Orogrande, Elk City, Dixie and Buffalo Hump sections. The cost is estimated at about $200,000.

LEWISTON, IDAHO.—The Lewiston-Clarkston Company will soon begin improvements to its steam power plant at Clarkston, Wash., and will also increase its electric power capacity from 1,500 hp to 3,600 hp. The 500-hp plant at Asotin will be replaced by a plant of 2,100 hp. The present equipment of the Asotin plant will be moved to Pomeroy Gulch, near Clarkston, where 500 hp will be developed. All of the equipment has been ordered. The company is now supplying electricity for Moscow and Genesee.

OREGON, ILL.—A Business Men's Association has been formed to co-operate with the Rochelle people for the purpose of carrying out the water-electric power scheme.

MASON CITY, ILL.—D. L. Waldron, city clerk, writes that bids will be received until June 18 for the construction of an electric light plant at a probable cost of $10,000. E. E. Saylor, of Saybrook, is engineer.

RICHMOND, IND.—Bids will be received by the City Clerk for improving and extending the municipal electric light plant.

NOBLESVILLE, IND.—The Indiana tin plate mill at Atlanta, has been sold to a company of Indianapolis and Atlanta citizens for $60,000.

SHELBYVILLE, IND.—A movement is on foot to organize another telephone company in this city for the purpose of constructing a new system.

INDIANAPOLIS, IND.—Instead of purchasing outright, as first announced, the Central Union Telephone Company has leased the Meridian Street Church property for a period of ninety-nine years. The company agrees to pay the owners $676,800 for the use of the site, on which they will erect an eight-story telephone exchange and office building. For the first fifteen years the company will pay $4,800 a year and $7,200 a year for the remaining eighty-four years.

MUSKOGEE, I. T.—Theo. Gulich, secretary of the Commercial Club, writes that the Spring River Power Company, of which Fred Lucas, of Joplin, Mo., is president is interested in the construction of a dam on Grand River for power purposes.

CLAREMORE, IND. TER.—A. Ross Moore, city recorder, writes that bids will be received about July 1 for the construction of water works and an electric light plant. The probable cost will be $40,000 or $50,000. W. P. Bullock, of Kansas City, Mo., is the engineer.

BEDFORD, IA.—J. J. Clark has made application to the City Council for a franchise to operate an electric lighting plant in this city.

DES MOINES, IA.—The Des Moines City Railway Company has completed plans for the construction of an interurban line from the Fair Grounds to Marquisville, a distance of six and a half miles.

OTTUMWA, IA.—The Ottumwa Railway & Light Company has awarded the contract for the construction of its new power house to

the Ottumwa Mill & Construction Company. The plant complete will cost about $115,000.

CEDAR FALLS, IA.—The Corn Belt Telephone Company is planning to expend from $15,000 to $25,000 in improvements to its system in this city, and has asked the City Council for permission to place its lines in conduits on Main Street.

IOWA FALLS, IA.—The Petersen Heat, Light & Water Company contemplates a number of improvements to its plants in this city and in Alden. J. H. Dusenberry, of Des Moines, has been appointed secretary to succeed C. H. Baker.

TOPEKA, KAN.—The Missouri & Kansas Telephone Company is considering extensive improvements to its Topeka exchange.

RICKTON, LA.—A local company has been organized to establish an electric lighting plant in this city.

HYATTSVILLE, MD.—Chas. L. Reeder, of Baltimore, has been selected as supervising engineer for the installation of the proposed electric light plant, which will cost about $12,000.

BALTIMORE, MD.—Subway Engineer Phelps has returned from a trip to Chicago, Detroit, Toledo, and other cities, where he inspected municipal and private lighting plants, for the Civic Federation. It is stated that he will shortly prepare a report for the Mayor and City Council with a view to establishing a municipal lighting plant in Baltimore.

ROCKVILLE, MD.—The Chesapeake & Potomac Telephone Company has purchased the property and franchises of the Enterprise Telephone Company, the consideration being $7,000. This gives the Chesapeake & Potomac Telephone Company control of all the telephone lines in the county. It is understood that many improvements will be made to the system.

BEVERLY, MASS.—The Beverly Gas & Electric Company is installing a 1,500-kw steam turbine in its power plant in this city.

WORCESTER, MASS.—H. H. Bigelow has petitioned the City Council for a right to operate wires in Worcester for the transmission of electricity under a franchise granted him in 1884.

WORCESTER, MASS.—A plan for lighting the city hall from the power plant in the basement is being considered by the City Council. If it should be decided to do this a 100-hp engine would be required.

HOLYOKE, MASS.—The Holyoke Street Railway Company has been authorized by the Railroad Commissioners to increase its capital stock by $150,000 to take up its floating indebtedness and to purchase additional equipment.

HUNTINGTON, MASS.—A contract for street lighting has been made with the Huntington Electric Light Company for the ensuing year at the rate of $15 for each 25-cp incandescent lamp, and $70 for each arc lamp.

FITCHBURG, MASS.—The Fitchburg & Leominster Street Railway Company has purchased a valuable water privilege located at the junction point of the towns of Ayer, Shirley and Harvard. The company proposes to develop power at this point.

REVERE, MASS.—An announcement has been made by the Suburban Gas & Electric Company that on July 1 a reduction of one cent per kw-hour will be made to the users of electricity for lighting purposes in Revere and Winthrop, and after that date patrons in both towns will be given free lamp renewals.

KINGSTON, MASS.—At a special town meeting held recently it was voted to authorize the committee chosen by the town of Kingston to purchase an electric motor or motors to be installed in the pumping station, and to contract with the Plymouth Electric Light Company for the extension of its lines to connect with the pumping station.

WORCESTER, MASS.—Arrangements have been made by which the Worcester & Providence Street Railway Company is granted the right to enter Providence over the tracks of the Rhode Island Company. The new company proposes to build a direct line from Worcester to Providence, a distance of 39 miles. Rights of way have been secured for the entire route.

NORTH ATTLEBORO, MASS.—At a recent meeting of the electric light commissioners it was voted to engage Sheaff & Jaasted, of Boston, to draw up plans and specifications and award the contract for installing the necessary machinery in the municipal electric lighting plant to furnish electricity for a commercial day power circuit. Considerable new machinery will have to be purchased and the town may have to be rewired.

MUNISING, MICH.—The citizens have voted to issue $30,000 bonds for water works and an electric light plant.

GRAND RAPIDS, MICH.—It is stated that the Thornapple Gas & Electric Company will expend about $200,000 in improvements.

BRONSON, MICH.—The electric lighting plant of W. H. Friedrich & Company has been destroyed by fire.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company contemplate an expenditure of more than $20,000 for additions to its underground and cable system in this city.

DETROIT, MICH.—The Detroit United Railway is preparing to extend its system from Flint to Saginaw and Bay City. The company will soon commence the extension of its system from Royal Oak to Almont.

DETROIT, MICH.—The Michigan State Telephone Company contemplates the erection of a large addition to its main buildings in this city and considerable extension of long distance lines through the State.

MANISTEE, MICH.—We are informed that the Manistee River development has been postponed for financial reasons, though it is possible that operation will be taken up this year. H. von Schon, of Detroit, is engineer.

MARINE CITY, MICH.—C. E. Blood, of Marine City, writes that Messrs. Hart, Ottaway and Marshall, are constructing a line through St. Clair County, and have an option on the private plant in Marine City. They expect to reconstruct the plant at Marine City.

NILES, MICH.—Traffic has been opened on the Niles-St. Joseph Railway Company's line between Niles and St. Joseph. It is stated the company contemplates the construction of a line from Niles to Buchanan, a distance of seven miles, and also a line from Michigan City to Carey, Ind., a distance of 25 miles.

SUPERIOR, MINN.—The City Council has authorized plans to be made for a municipal electric lighting plant for the city.

MINNEAPOLIS, MINN.—The Committee on Gas has awarded the contract for electric lighting for the balance of the year to the Minneapolis General Electric Company, at $7 per arc lamp per month.

ST. CLOUD, MINN.—O. T. Hougen, of Grand Rapids, Mich., secretary and treasurer of St. Cloud Electric Power Company, writes that this company will expend on its proposed dam and for the development of power about $400,000. J. C. Jacobson, of Grand Rapids, Wis., is engineer.

BROOKHAVEN, MISS.—The Board of Aldermen is considering the question of remodeling the water works and electric light plant. The probable cost of improvements is $30,000.

KANSAS CITY, MO.—Burns & McDonnell, Engineers, state that the probable cost of developing the water power of Big Mangua River, will be $1,200,000.

ST. CHARLES, MO.—The bill passed by the City Council at a special meeting held recently granting a twenty-year electric light franchise to St. Louis parties, has been vetoed by the mayor.

TWIN BRIDGES, MONT.—The Madison River Power Company, of Twin Bridges, is contemplating the construction of a new power plant on Madison River to furnish power to the Butte mines and smelters. Geo. H. Potter, of Butte, is making surveys for the work.

BEATRICE, NEB.—The Home Telephone Company has completed arrangements for the installation of a new switchboard equipment to be put in at once. The cost will be about $20,000.

CRETE, NEB.—The City Council is contemplating some extensive improvements to the municipal electric lighting plant, and is asking for bids for a 50 to 90 hp engine and for electric generators. L. C. Dredla is city clerk.

MANCHESTER, N. H.—The Manchester Traction, Light & Power Company has purchased the property and rights of the Goff's Falls, Litchfield & Hudson Street Railroad and will construct the line at once. The road will be 18 miles long and will connect with the Manchester & Nashua street railway system.

BURLINGTON, N. J.—Municipal ownership of the lighting system of the city is under consideration here.

WEST ORANGE, N. J.—The Town Council has awarded to the Public Service Corporation, the contract for lighting the streets for 5 years at $85 per lamp per year.

SUMMIT, N. J.—The Morris County Traction Company has applied to the Common Council for a 40-year franchise for an electric railway from Summit to Elizabeth.

NEWARK, N. J.—A number of merchants on Broad and Market Streets are becoming interested in the individual power and lighting question. Marshall & Ball and J. Lissner & Sons have decided to produce their own light and power, and have engaged Edward J. Kunze to design plants for them. The electricity generated will be used for the running of elevators, fans, other apparatus, as well as for furnishing light.

MINEVILLE, N. Y.—The Witherbee Sherman Company, of Fort Henry, has made arrangements to erect a lighting plant. H. C. Pelton, of New York, is architect.

SYRACUSE, N. Y.—The Syracuse Lighting Company has ordered a 1,500-kw steam turbine and other apparatus, which will increase the capacity of the plant 3,000 hp. E. B. Doan is superintendent.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has announced to the users of electricity in dwelling houses a reduction in price of electricity from 14 cents to 10 cents per kw-hour, with a minimum charge of $1 per month.

ROCHESTER, N. Y.—The American Wood Working Machinery Co. has recently ordered from the Crocker-Wheeler Company, of Ampere, N. J., a 220-kw, 250-volt, direct-current generator, to supply power for additional equipment added to its plant.

WILLIAMSON, N. Y.—The Sodus Gas & Electric Company, of Sodus, has been granted a franchise to operate an electric lighting system in this village. The company has commenced work on the extension of its system, and will soon be ready to supply electricity in the town.

WAVERLY, N. Y.—G. Tracy Rogers, of Binghamton, has purchased the entire interest of J. A. Powers, of Troy, in the Waverly, Sayre & Athens Traction Company. The line has been owned jointly by Messrs. Powers and Rogers. The purchase of the Waverly trolley line carries with it the ownership of the electric lighting and power company of both places.

NEW YORK, N. Y.—Bids will be received until June 18 by C. B. J. Snyder, Superintendent School Buildings, for repairs, alterations and additions to the electric bell system, systems and electric lighting and telephone systems in Schools Nos. 1, 20, 34, 42, 92, 108, 120, 147, 160 and 177, Borough of Manhattan; also for installing electric equipment in School No. 78, Borough of Queens.

ALBANY, N. Y.—The United Message Company, of Albany, has increased its capital stock from $10,000 to $10,000,000. The company is an independent telephone concern. Of the capital stock heretofore authorized only $700 has been actually issued. Elyria, Ohio, telephone capitalists are interested in this company, which is to be a holding company for independent telephone companies in this State.

ROCHESTER, N. Y.—Governor Higgins has signed the bill which permits the city of Rochester to amend its charter so that a contract for city lighting may be awarded to the lowest bidder even when the company has no plant established in the city, and provides that the Council may grant a 50-year franchise to such company. Mayor Cutler is considering the immediate advertising for the municipal lighting contract. The present contract expires July 1, 1907.

ETON COLLEGE, N. C.—The faculty of Eton College has voted to expend $15,000 for electric lights, steam heat and water system for dormitories and college buildings.

SALISBURY, N. C.—At a recent meeting of the Salisbury-Spencer Electric Railway, the following officers were elected: E. M. Deane, of Grand Rapids, president; Dwight Smith, of Salisbury, treasurer. The company, it is said, will reduce the price of electricity and gas.

MOORESVILLE, N. C.—Bonds to the amount of $10,000 have been voted for the construction of a 75-kw arc and incandescent plant. Generating equipment, including boiler and pump, has been purchased. It has not yet been decided how the power line and arc lighting system will be arranged for. A. L. Starr is Mayor. G. Bonham Bird, of Biltmore, N. C., is the engineer.

PIQUA, OHIO.—The Council is considering the construction of an electric light plant, to cost about $18,000.

HUDSON, OHIO.—The question of issuing $10,000 bonds for an electric light plant will probably soon be voted upon.

ELYRIA, OHIO.—The Garford Company of this city has recently ordered from the Crocker-Wheeler Company of Ampere, N. J., three 150-kw, 250-volt, gas engine driven generators.

SPRINGFIELD, OHIO.—Stewart L. Statum, city solicitor, has been instructed by the Council to make an investigation of the project of erecting a municipal light, heating and power plant by the city.

LIMA, OHIO.—The city is making important improvements to its water works pumping station and is installing a 300-hp direct connected engine and generator for lighting the station and operating pumps at several distant points.

CINCINNATI, OHIO.—The Cincinnati & Eastern Electric Railway, operating from Cincinnati to New Richmond, and one of the three lines operated under the name of the Interurban Railway & Terminal Company, has been leased to the Union Gas & Electric Company, which was recently formed to lease the Cincinnati Gas & Electric Company.

YOUNGSTOWN, OHIO.—The Cherry Valley Iron Company, of Leetonia, has submitted a proposition to the Youngstown & Ohio River Railway, to furnish electricity for the operation of its line from its large power station at Leetonia. The station has a capacity of 2,500 hp at present and could easily be enlarged to operate the electric railway.

ASHTABULA, OHIO.—At a recent election held in this city the proposition to spend $50,000 to improve and enlarge the municipal lighting plant was defeated. The Council will consider a proposition recently made by a company to purchase the city lighting plant. The company will take a water franchise and erect a million dollar water, lighting and power plant.

TOLEDO, OHIO.—The Lima & Toledo Traction Company is securing right of way for an independent entrance to Toledo. It is stated that the company will locate a large power station near Miami on the Maumee River. When completed this will handle the Lima and Toledo line, the Lima city lines and the line being built from Lima to Bellefontaine.

TIFFIN, OHIO.—A company composed of Columbus, Pittsburgh and Philadelphia capitalists has secured the ownership or options on six water powers between Tiffin and Ft. Seneca on the Sandusky River. It is proposed to erect a power house near Ft. Seneca where there is a fall of 75 feet. It is estimated that from 2,000 to 3,000 hp can be secured for ten months in the year. The power is to be used in operating traction lines radiating from Tiffin and for the reduction of aluminum, as the clay deposits within a few miles of the river are said to be rich in this mineral.

OKLAHOMA CITY, OKLA.—The Oklahoma City Street Railway Company contemplates various improvements and extensions to its lines this year.

AURORA, ORE.—The Aurora Electric Company is making arrangements to install a day service on its entire system.

SALEM, ORE.—The Salem Electric Light & Traction Company is making extensive improvements and additions to its power plant. Two boilers have been added and a new 600-hp engine has been installed. The company is planning several extensions to its street car lines. B. K. Page is manager.

PRINEVILLE, ORE.—F. H. Goudy, of the firm of Forbes & Goudy, of Portland, has filed at Prineville notice of appropriation of the waters of Deschutes River, for the purpose of irrigating land in Agency Plains and Haystack Districts, to supply water for domestic purposes, and to furnish electricity for lighting and power purposes.

PENNSBURG, PA.—The Town Council has passed an ordinance in favor of the construction of an electric light plant.

LANCASTER, PA.—The City Council has awarded a contract to the Edison Electric Illuminating Company for street lighting for five years at $85 per arc lamp per year.

BLOOMSBURG, PA.—The Farmer's Mutual Telephone Company will be established in this city, and will also operate a telephone system in the upper end of Columbia and Montour counties.

FRANKLIN, PA.—The Franklin Electric Company has recently ordered of the Westinghouse Machine Company, of East Pittsburg, a 125-hp, 3-cylinder vertical type gas engine to increase the capacity of its lighting plant.

ALLENTOWN, PA.—The Consolidated Telephone Company has leased the plant of the Easton & Bethlehem Telephone Company for 999 years, and has purchased the plants of the Honesdale Telephone Company and the Berwick Telephone Company.

PHILADELPHIA, PA.—The Commonwealth Electric Company has withdrawn its application from the Councils for a franchise in this city. J. Collins Jones, counsel for the incorporators, states that the company has not abandoned its purpose to enter the electric field in this city. The company will submit new measures to the Councils next September for limited electric light franchises.

YORK, PA.—General Alexander Brown has announced that the Maryland & Pennsylvania Railroad will be operated by electricity instead of steam. The company has engaged electrical engineers to make an estimate of the cost of the necessary equipment. The electric power will probably be used at first as far as Belair and later into York.

HARRISBURG, PA.—It is reported the York Haven Water & Power Company has made arrangements with the Harrisburg Light, Heat & Power Company to supply it with electricity for general purposes, lighting, heating and operating motors. The York Haven Heat & Power Company will erect a sub-station at the eastern limits of the city of Harrisburg for the purpose of distributing the current. Transformers, switchboards and the necessary electrical equipments will be installed as soon as possible.

TIVERTON, R. I.—At the annual meeting of the Tiverton Light & Power Company, held recently, it was decided to begin work at once on the construction of a new plant. John R. Hicks is president, and George R. Lawton, secretary, both of Tiverton.

NINETY-SIX, S. C.—This town is considering the construction of water works and an electric light plant.

ST. MATTHEWS, S. C.—Bids will be received until July 2 by Leonidas Cain, Secretary Board Public Works, for $20,000 water works and electric light bonds.

MEMPHIS, TENN.—The Laclede electric plant is to be established. A site for the plant has been purchased, and work will begin at once on the plant. The machinery has already been ordered. L. G. Van Ness, of St. Louis, Mo., will be local manager of the company, which will be organized at once. It is understood that the plant will cost about $60,000.

McKINNEY, TEX.—Plans have been completed for improving the electric light plant. F. W. Perkins is Mayor.

AUSTIN, TEX.—The Southwestern Telephone & Telegraph Company, which operates in Texas and Arkansas and other Southern States, will increase its capital stock from $5,000,000 to $20,000,000.

MARBLE FALLS, TEX.—Reed & Badger have recently purchased an electric lighting plant. They will furnish electricity to light the town and use electric power in their lumber yard.

DALLAS, TEX.—The Southwestern Telephone & Telegraph Company contemplates laying about five miles of additional conduit, and will soon apply to the City Council for permission to do the underground work.

TEMPLE, TEX.—The Temple Electric Light Company is making extensive improvements and increasing the capacity of its power plant. Three new dynamos and a new Russell engine have recently been installed in the new addition to the power house.

PAROWAN, UTAH.—The citizens have voted to issue bonds for establishing a lighting plant.

AMERICAN FORK, UTAH.—The Intermountain Consolidated Railway Companies has applied to this city for a 50-year franchise to build and operate an electric railway.

HUNTINGTON, UTAH.—Wm. Howard, president and general manager of the Electric Light & Milling Company, writes that owing to complications in regard to franchises, the receiving of bids for constructing the proposed plant has been postponed indefinitely.

RUTLAND, VT.—The Rutland Railway, Light & Power Company will issue $1,200,000 40-year bonds for immediate use to acquire the property of the Rutland City Electric Company and to extend and improve its present holdings.

BURLINGTON, VT.—The special committee appointed by the Common Council to investigate the matter of a city lighting system, has reported in favor of municipal ownership. The Council has deferred action on the report until a further investigation is made by the committee to ascertain whether or not the city can legally furnish lamps for other than public use.

LEXINGTON, VA.—Robert Hutton, general manager of the Lexington Light & Power Company has placed orders for a 4,000-light dyna-

mo and a 240-hp turbine. The equipment is expected to be installed by early fall.

RICHMOND, VA.—The question of a municipal electric lighting plant is under consideration in this city, and upon the report of the consulting engineer, E. W. Trafford, being read, it was decided to postpone further action to June 14.

FT. MYER, VA.—Bids will be received until June 20 by Capt. A. W. Butt, Quartermaster, U. S. A., Quartermaster's Department, Washington, D. C., for furnishing and installing electric fixtures and meter in bachelor officers' quarters, and constructing feeder line and making service connections at Ft. Myer.

WAVERLY, WASH.—A franchise has been granted to E. H. Morrison to operate an electric light and power system in the town.

OLYMPIA, WASH.—M. F. Kincaid and associates have been granted a franchise by the City Council to operate a lighting, heating and power plant.

TACOMA, WASH.—The Pacific Traction Company has made application to the County Commissioners for franchises for two electric railways into Tacoma. One of the roads will connect Tacoma and Olympia, and the other will connect Tacoma and Steilacoom.

TACOMA, WASH.—Work has been started by the Stone & Webster interests, who control the street railways of Seattle and Tacoma, and other large electrical properties in the Puget Sound region, on a large hydro-electric power plant near Buckley, this county. The plant will develop 50,000 hp, and two years will be required for its construction. The complete plant will be more than double the size of the plant at Electra, owned by the same company. The additional power will be used by Stone & Webster's present electric systems and new lines to be built. The plant will cost from $3,000,000 to $5,000,000.

MARTINSBURG, W. VA.—The City Council has granted Stuart W. Walker and James H. Thompson the right to construct an electric-railway in the city. Steps will be taken immediately to organize a company. The company proposes to build a line from this city to Shepherdstown, Harpers Ferry and Charlestown.

MARTINSBURG, W. VA.—Officers of the Martinsburg Power Company have awarded contracts aggregating $135,000 for the construction of a large power plant at dam No. 4 on the Potomac River, about 15 miles from this city. The company has secured the right to use the surplus water of the Potomac from the Chesapeake & Ohio Canal Company.

SPOONER, WIS.—This village will install a larger dynamo in the electric light plant.

STOCKBRIDGE, WIS.—The Stockbridge & Sherwood Telephone Company has been incorporated with a capital stock of $2,000 by Joseph Bast, G. P. McKenney and others.

EAU CLAIRE, WIS.—It is stated that the Chippewa Valley Electric Railroad Company is contemplating the construction of an electric railway to connect Eau Claire and Menomonie.

REGINA, CAN.—The Council has granted a franchise to the Grand Trunk Pacific Railway Company for an electric railway.

EDMONTON, CAN.—Plans have been prepared by the city engineer for an electric railway in this city at an estimated cost of $66,000.

WINNIPEG, MAN.—The new power plant of the Winnipeg Electric Street Railway Company, on the Pinnawa Channel, Winnipeg River, was put into operation on May 31. The plant is located sixty miles from the city and is capable of developing 10,000 hp, which is transmitted to Winnipeg for the company's street railway system, lighting and manufacturing purposes.

OAXACA, MEX.—An electric light and power plant is to be installed at Oaxaca. Governor Emilio Pimentel can give information.

MEXICO CITY, MEX.—The Compania Electrica Anglo-Mexicana has been organized in England for the purpose of installing electric power plants in Mexico.

GUERRERO, MEX.—Telesforo Macias has been granted a concession by the Federal Government to install an electric power plant on the Salado River near here.

MEXICO CITY, MEX.—Engineer Luis Espinosa, acting on behalf of the Federal department of public works, has entered into a contract with Schondube & Neugebauer, of this city, for the installation of four 100-hp, three-phase motors at the San Lazaro water plant.

GUADALAJARA, MEX.—The San Pedro Analco Mining Company is erecting a large hydro-electric plant at San Pedro Analco, State of Jalisco. The plant will have a capacity of 5,000 hp. It will furnish electricity for operating machinery and mills of the company's mines.

TAMOSOPA, MEX.—An electric light and power plant is being installed at the ranch of Dr. H. B. Tanner, near Tamosopa. The plant will furnish electricity for operating the machinery of a sugar mill and other plantation machinery and for lighting the buildings on the place.

MEXICO CITY, MEX.—A British company, which has its headquarters in London, Eng., is said to have purchased the Portezuelo waterfalls, situated in the State of Mexico. The company will install an electric power plant and transmit the electric power to Mexico City.

MEXICO CITY, MEX.—Garcia Brothers have been granted a concession by the Federal Government for the use of certain waterfalls on the Cupatitzio River, in the State of Michocan, for generating electricity. The electric power will be transmitted to mines and industrial concerns of that region.

MEXICO CITY, MEX.—The National Congress has approved the contract which was entered into by the Federal Government and the Mexican Light & Power Company, through its attorney, Charles H. Cahan, which authorizes the company to utilize the waters of the Tenango, Necaxa and Catepuxtla rivers, State of Puebla, for power purposes.

PARRAL, MEX.—The installation of the electric power plant for Pedro Alvarado at Parral will soon be completed. The plant has a capacity of 1,000 hp, and will furnish electricity for operating machinery in the Palmillo mine and the large stone quarries which are owned by Mr. Alvarado. The contract for installing the plant is held by Weisel & Kook, of Parral.

MEXICO CITY, MEX.—The Federal Government has granted a concession to the representative of an American company for the erection of a large hydro-electric plant on the Yaqui River, in the State of Sonora. The company is granted the authority to build long-distance transmission lines to towns and industrial centers of that part of Mexico. It will take seven years to complete the installation of the plant.

MAZATLAN, MEX.—A large electric power plant is being installed at the Guadalupe de los Reyes mines, in the State of Sinaloa. The plant will have a capacity of 5,000 hp and will cost about $800,000. The erection of the plant is being done under the direction of Engineer Robert McDoble, of San Francisco, Cal. The initial power for the plant will be obtained from water falls on the Piaxtla River. The plant will furnish electricity for the mines and mills of the Guadalupe de los Reyes Company.

COLIMA, MEX.—The Compania Potencia Electrica de Colima, which is installing a large electric power plant on the San Antonio hacienda at the foot of Mt. Colima volcano, will soon have its transmission line to the city of Colima completed. The distributing station at Colima has been finished. The company has secured private lighting contracts for 3,000 incandescent and a number of arc lamps in Colima and for furnishing electricity for a large number of industries. More than $300,000 has already been expended in the enterprise. Arnold Vogel is president.

PORT HOPE, ONT.—At a recent meeting of the Town Council a by-law was passed authorizing the issue of $7,400 bonds for the purpose of establishing a municipal electric lighting plant.

HAMILTON, ONT.—The shareholders of the Hamilton, Caledonia & Lake Erie Railway have decided to build an electric railway to Caledonia and Dunville.

KINGSTON, ONT.—The Kingston, Gananoque & Perth Electric Railway has applied to the Legislature for permission to build an extension of its line from Lanark to Arnprior.

TORONTO, ONT.—The Ontario government has plans for electrifying the Temiskaming Railway from North Bay to Englehart, a distance of 137 miles. The cost is estimated at $1,000,000.

OWEN SOUND, ONT.—Extensive improvements are to be made to the municipal electric lighting and gas plants, which will cost about $50,000. Joseph McLinden is chairman of the lighting commission.

New Industrial Companies.

THE STANDARD ELECTRIC COMPANY, of Portland, Ore., has filed articles of incorporation with a capital stock of $15,000. The incorporators are John C. Baird, Frank E. Harmar and Fred A. Waltz. The company proposes to carry on a general electric business, and to buy and sell electric and gas fixtures.

THE PIONEER ELECTRICAL CONSTRUCTION COMPANY, San Francisco, Cal., has been incorporated to engage in the electrical and construction business, with a capital stock of $1,000,000. The directors are R. Johnson, R. V. Whiting, F. H. Gould, L. Dunne, E. B. Gould, John H. Hensen and C. E. Arnold.

THE WIND MILL ELECTRIC COMPANY, of Noblesville, Ind., has incorporated to manufacture and sell electrical apparatus to produce light and power by the use of wind mills. The directors are C. C. Curtis, Fred. E. Heylman, J. C. Jones and R. W. Wilson.

THE SELBYVILLE FOUNDRY & MACHINE COMPANY, of Shelbyville, Ind., has been incorporated with a capital stock of $50,000. The company will build a large factory for the manufacture of gasoline engines and electrical apparatus. S. H. Meyers is president and C. D. John, secretary.

New Incorporations.

NEW CASTLE, PA.—The New Castle Telephone Company has filed articles of incorporation with a capital stock of $5,000.

MONTESANO, WASH.—The Grays Harbor & Puget Sound Railway Company has been incorporated to build an electric railway from Montesano to Olympia.

JONESBORO, ARK.—Articles of incorporation have been filed with the Secretary of State by the Automatic Home Telephone Company with a capital stock of $100,000. The incorporators are H. H. Houghton and others.

NAPA, CAL.—Articles of incorporation have been filed by the San Francisco, Vallejo & Napa Valley Railroad Company. The new company, has a capital stock of $1,500,000. The directors are: W. F. Botsford, of Los Angeles; Z. J. Hatch, of Oakland; L. J. Peroy, of Napa; J. T. York, of Napa, and T. W. Hatch, of Vallejo.

GRAND JUNCTION, COL.—The Red Lands Irrigation & Power Company has been incorporated, with a capital of $500,000, by Benjamin F. Kiefer, H. C. Wagner and others, of Grand Junction.

SHELLEY, IDAHO.—The Cedar Point Power & Light Company has been incorporated, with a capital of $25,000.

BOISE, IDAHO.—The Idaho Electric Light & Power Company has been organized for the purpose of building a dam and installing a 1,200 hp plant on the Payette River, three miles from Payette, for furnishing electricity to the city. P. A. Snyder is president, and W. A. Coughanour, vice-president.

GILMER, ILL.—The Gilmer Exchange Telephone Company has been incorporated with a capital stock of $850. The incorporators are George Steinagel and others.

PALMYRA, ILL.—Articles of incorporation have been filed with the Secretary of State by the Hannibal Light & Fuel Company with a capital stock of $160,000. The incorporators are John Dell and others.

MARION, IND.—The Citizens' Automatic Telephone Company has filed articles of incorporation with the Secretary of State, with a capital stock of $300,000. The incorporators are O. L. Barger, Albert E. Wilson and E. K. Wilson.

SPURGEON, IND.—The Spurgeon Independent Telephone Company has been incorporated with a capital stock of $2,000. The company is in the market for a new switch board and material to install a new plant. B. A. Humphreys is president.

ANDERSON, IND.—The three local light and gas companies have been merged in a new corporation to be known as the Union Gas Light and Fuel Company. The new company has a capital stock of $500,000. The directors are C. W. Hoover, J. H. Millspaugh, H. L. Millspaugh, H. C. Sisco and Jasper Vance.

TOPEKA, KAN.—A charter has been granted to the Topeka Electrical Company by the State charter board. The company has been organized to furnish electricity for light and power. It is capitalized at $200,000.

OSWEGO, KAN.—The Kansas Traction Company has been organized for the purpose of promoting an electric railway from Cherryvale to Columbus. S. B. Miller is president and C. A. Wilkin, secretary.

COFFEYVILLE, KAN.—A company has been formed for the purpose of building an electric railway from this city to Forest Park, and application will be made immediately for a charter. The directors are W. H. Shepard, L. L. Birmingham, Dean Gill, S. D. Frazier, James Stanton, C. L. Hollingsworth and J. B. Tackett. The company will have a capital stock of $35,000.

AUGUSTA, ME.—The Consolidated Railway, Electric Lighting & Equipment Company has been organized with an authorized capital stock of $16,000,000. The promoters are Isaac L. Rice, James L. Weston, W. B. Lord and George W. Hoyt, of New York; M. H. Simmons, of Hallowell; Lewis A. Burleigh, I. L. Fairbanks, J. Berry and I. E. Chadbourne, of Augusta. The company proposes to deal in gas and electricity and build railroads and establish steamship lines.

GRASS LAKE, MICH.—The Portage Telephone Company has been incorporated with a capital stock of $900.

PALO, MICH.—The Fenwick Telephone Company has been incorporated with a capital stock of $8,000.

HARTWICK, MICH.—The Osceola Telephone Company has been incorporated with a capital stock of $3,000.

LANSING, MICH.—The Northern Light & Power Company has been incorporated with a capital stock of $625,000.

MONTROSE, MICH.—The Northern Light & Power Company has been organized, with a capital of $625,000, to develop the water power of Flint River, at Montrose.

RIVES, MICH.—The Rives Telephone Company has filed articles of incorporation with a capital stock of $1,000. The incorporators are Fred Marquedart, Henry K. Wood and others.

HANLEY FALLS, MINN.—The Hanley Falls Telephone Company has been organized with a capital stock of $10,000. The officers are I. Johnson, president; L. Orwoll, vice-president; W. E. Hanson, secretary; H. M. Hanson, treasurer.

TORONTO, OHIO.—Articles of incorporation have been filed by the Toronto & New Cumberland Telephone & Telegraph Company with a capital stock of $15,000. The incorporators are W. S. Hooloway and others.

LENZBURG, MO.—Articles of incorporation have been filed with the Secretary of State by the Risdon Telephone Company. The incorporators are Dan Waeltz, Adam Kirchoefer and others.

LEBANON, PA.—The Lebanon Electric Light Company has been incorporated with a capital of $10,000.

Obituary.

MR. J. W. RONEY.—We regret to note the death of Mr. J. W. Roney, the local manager of the Richmond, Ind., Light, Heat & Power Company for a number of years. He entered the gas business with Mr. James Starr in 1891 and went with the plant when it was sold to Mr. J. E. Lowes, of Dayton, in 1893. He remained with the company also when it was purchased by the well-known holding corporation, the United Gas & Electric Company, of New York City. He had in this way given continuous service from the date of his first connection with the plant in 1891, and his death is deeply felt by his associates.

Personal.

MR. N. A. CHRISTENSEN.

MR. NIELS A. CHRISTENSEN, whose services have just been secured by the Allis-Chalmers Company, of Milwaukee, which will make the brakes and air compressors bearing his name, was born at Toerring, Denmark, in 1865, and after a very successful career as a designer, engineer and inventor in Denmark and England, as well as in India and Chili, he came to this country in 1891, entering at once the employ of the Fraser-Chalmers Company, as a designer of Corliss engines and its valve gear, to which other duties were soon added. An accident on an electric railway led him to note the defects of hand brakes on trolley cars, and he then developed the Christensen scheme of applying air brakes to such cars, subsequently securing patents here and in Europe. The first practical tests were made at Detroit in 1893, and since that time the Christensen types of brake have become very widely known, the commercial exploitation dating from 1896. The Christensen Engineering Company was organized in Milwaukee, in the early part of the year 1897. At the outset Mr. N. A. Christensen did practically all the work of designing, selling, installing and collecting, but before the close of the first year the business had grown so that it demanded more assistance and Mr. F. C. Randall (now district manager of the Allis-Chalmers Co., at New York) was induced to associate himself with the company as chief of the sales department, and, with his active and successful management, the business grew so rapidly that the sales of air brakes in 1904 aggregated nearly $1,300,000. In the fall of 1902, against the judgment of Mr. Christensen, who was not himself a stockholder in the company, it was decided to broaden the scope of the business and include general electrical manufactures. This step led to his retirement as general superintendent and the Christensen Engineering Co. was later merged in a new corporation known as the National Electric Co. Mr. Christensen engaged in the business of constructing air compressors and others of his patented articles, leaving to the company the construction of air brakes for electric cars under his patents, he receiving a royalty for their use. The National concern went into the hands of a receiver in the spring of 1905, and was adjudged a bankrupt. During the early part of 1903 the company sought to avoid the payment of royalties to Mr. Christensen, and after being operated for ten months under a receivership, was sold at public auction to interests representing the Westinghouse Air Brake Company, which, it is stated, legally surrended all rights, title and interest to all the Christensen patented devices, and also settled the claims of Mr. Christensen against the National Electric Company and its receiver. Since this settlement, negotiations have been brought to a successful issue with Mr. Christensen for the consolidation of the Christensen air brake and compressor business with the great interests of the Allis-Chalmers Company, Mr. Christensen himself going to this institution as consulting engineer.

MR. R. A. C. SMITH, the financier, who has large electrical interests, has just returned home from Europe.

MR. GEORGE W. WOOD, of the Boston office of the General Electric Co., has accepted a position as superintendent of the municipal electric lighting plant of Mansfield, Mass.

MR. R. C. CLOWRY, president of the Western Union Telegraph Company, has just returned from a very pleasant trip around Europe, much benefited by the rest and change.

MR. R. W. POPE, secretary of the American Institute of Electrical Engineers, has sailed this week for London, to participate in the hospitalities extended by the Institution of Electrical Engineers.

DR. S. S. WHEELER, president of the American Institute of Electrical Engineers, sailed this week on the "Barbarossa" to attend the meeting in England with the Institution of Electrical Engineers of Great Britain, details of which have already been given.

MR. A. S. HILLHOUSE, general manager of the Stark County Telephone Company, Canton, O., has been appointed chief engineer of the Cuyahoga Telephone Company, of Cleveland. Mr. Morton Perdue, general superintendent of the Stark Company, has been promoted to the vacant position.

MR. FREDERICK C. HOWE, a well-known lawyer of Cleveland, partner of Professor Garfield of Princeton for many years, and author of a book on "The City," has written for the July *Scribner*, as a result of his personal investigations, an article on the municipal government of Glasgow.

MR. J. F. AHLERS has resigned his position as city electrician of Tampa, Fla., which he has held for thirteen years. He is manager of the Big Sandy Telephone Pin and Bracket Company, of Louisa, Ky., and is about ready to turn out locust pins and side brackets for the general electrical market.

MR. A. H. HACKEMAN, for many years prominent in the meter department of the New York Edison Company, has recently become engineer for the New York office of the Electric Storage Battery Company. He received some substantial testimonials from his old associates on making the change.

MR. JOSEF LEIDENER, electrical engineer, secretary of the Elektrotechnischen Verein of Vienna, and editor of the *Zeitschrift Elektrotechnik and Maschinenbau*, is a visitor to this country for the first time, and is making a study of American electrical methods and plants. He is an acute observer and is taking a deep interest in all that he sees differing from European practice.

PROF. K. OGURA, of the Imperial University of Kyoto, is in this country on an extended leave of absence in order to make a study of engineering practice prior to returning to his duties. For the past seven years Prof. Ogura has been the assistant of Prof. M. Namba, head of the University Electrical Engineering department, during part of which time he taught electrochemistry.

PROF. I. FUJIOKA, of Japan, who has been visiting this country again after a long absence, has sailed for England this week, taking with him his son now a student in this country. They will participate in the Institute hospitalities on the other side. Prof Fujioka, who is an honorary member of the National Electric Light Association, attended the annual meeting at Atlantic City last week.

MR. WILLIAM CLEGG, JR., who has been special agent of the Westinghouse Electric & Manufacturing Company in its St. Louis territory, has just received the appointment of acting manager of the St. Louis office. Mr. D. E. Webster, formerly manager of the office, has been transferred to a position in the Chicago sales office of the company. Mr. J. S. Trittle has been appointed acting manager of the new district office opened by the Westinghouse Electric & Manufacturing Company in the New England Building, Kansas City, Mo. Mr. Trittle was formerly connected with the St. Louis office of the Westinghouse Electric & Manufacturing Company.

PROF. ELIHU THOMSON addressed recently the Electric Meter and Instrument Association of Lynn, Mass., at its annual dinner, and gave some interesting details as to the Thomson meters, the first of which was made in 1888 and shown at the Paris Exposition the next year. In 1889 also, the Thomson recording wattmeter was invented, continuing in use up to the present time. Mr. Cox, the toastmaster, stated that in 1890 the Thomson meter factory started with a capacity of 50 meters a week, while at the present time nearly 5,000 weekly are turned out. The Association was founded about two years ago and has been very successful.

Trade Publications.

INJECTORS.—The Hayden & Derby Manufacturing Company, 85 Liberty St., New York, has issued an illustrated catalogue presenting a complete line of injectors, ejectors, jet apparatus and water heaters.

VENTILATORS.—The Burt Manufacturing Company, Akron, O., has issued a neat booklet devoted to the Burt combination sky-light and ventilator for factories, boiler houses, power houses, anl other buildings where light and ventilation are needed.

ELECTRICALLY-OPERATED WATER-TIGHT DOORS.—Bulletin No. 15 of the "Long-Arm" System Company, Cleveland, O., gives an interesting discussion of the features of electrically operated bulkhead doors including a convincing argument as to the special advantages possessed by electricity in comparison with hydraulic power for closing the doors.

DESIGN OF LOCOMOTIVES.—Catalogue No. 54 of Burnham, Williams & Company, Philadelphia, Pa., contains a most interesting and valuable record of recent constructions at the Baldwin Locomotive Works. The catalogue is divided into parallel columns printed in French and English. Photographs are reproduced of 14 locomotives, for each of which all of the principal dimensions are given in both French and English units.

TRAIN LIGHTING.—Complete constructional details of belt-driven electrical equipments for the lighting of railroad cars are given in bulletin No. 30 recently issued by the Bliss Electric Car Lighting Company, Milwaukee, Wis. One of the most prominent features of the Bliss system resides in the use of a counter-voltage generator which assists in keeping the electromotive force on the lamp circuit at a constant value independent of the variations of speed of the main generator.

THE CENTRAL ELECTRIC COMPANY, of Chicago, general Western agent for "Deltabeston" magnet wire, is sending out new lists announcing a reduction in price on this wire. It has been felt that the only objection heretofore against the use of "Deltabeston" wire in preference to a cotton covered magnet wire for winding field and armature coils on railway motors, has been the cost, and this objection has now been removed. As general Western agent for D. & W. material, the Central Electric is also sending out copies of the new D. & W. price list. This price list is an attractive booklet small enough to be carried in the pocket, and quotes revised prices on D. & W. enclosed fuses and safety devices.

LEEDS & NORTHRUP COMPANY, of 4901 Stenton Avenue, Philadelphia, has just issued an extremely interesting and well compiled pamphlet illustrative and descriptive of its new shops and laboratory near Wayne Junction, an ideal location for its work. The handsome building, erected with a special view to the class of high-grade electrical apparatus to be produced, is three stories high, fireproof, 110 by 55 feet. The material is reinforced concrete. The light is admirable. The views show excellent arrangements for manufacture, testing, etc., and the text shows clearly that the most modern methods have been adopted throughout. A list is given in some detail of the various scientific and commercial instruments of precision made by this young, energetic and enterprising firm.

News of the Trade.

THE LIMA INSULATOR COMPANY, Lima, O., has, through the G. E. Watts Co., Atlanta, Ga., obtained a contract from the Savannah River Power Company for between 6,000 and 7,000 high-tension insulators and pins, for a working voltage of 30,000 with a testing voltage of 70,000.

THE ELECTRIC CABLE COMPANY, of 17 Battery Place, New York City, has just received an additional order from the New York & Long Island Railroad Company for six miles of 300,000 c. m. Voltax cable. This order, coming as it does, after one placed some months ago, with the Electric Cable Company, by the same company, for 15 miles of cable, conclusively proves the satisfaction given by Voltax, the insulating compound.

KOHLER BROS., of Chicago, through their Pacific Coast manager, Abner Doble Company, have just finished installing a four-motor Kohler equipment for the new octuple Hoe press, which the San Francisco *Examiner* has installed and placed in operation in its temporary building in San Francisco. They have also closed a contract for a two-motor Kohler equipment for a sextuple Hoe press, which is now being shipped for the San Francisco *Call* for installation in its old building at Third and Market Streets.

OKONITE CABLES FOR N. Y. CENTRAL.—In the article in our issue of June 2 on laying eight cables simultaneously for the New York Central in the Harlem River, the language used gives the idea that the Okonite cables included were armored and finished at Bayonne. We are advised by Manager W. L. Candee that the Okonite cables referred to were made, armored and finished at the Okonite factory at Passaic, N. J., where the company has the facilities for manufacturing, and has made some of the very largest submarine cables without any kind of assistance from any other manufacturer.

DODGE & DAY, engineers, of Philadelphia, have completed plans for the new works of the Arthur Koppel Company of New York and Berlin, Germany. Construction work will be started at once and the plans contemplate the immediate erection of a section of the erection shop, the light car shop, the switch shop, service building and office building and a part of the power plant. The works are situated at Homewood, a place about 35 miles from Pittsburg, and will make many of the products which have hitherto been imported by the Arthur Koppel Company from Germany. Mr. H. A. Ellis will have charge of the new plant and is now arranging for the building of the plant. He has established an office at 1771 Frick Building Annex, Pittsburg, Pa.

WESTINGHOUSE GAS ENGINES.—The United States Steel Corporation was perhaps the first large mill operator which began the operation of gas engines with producer gas and that company has a number in use. In the rail mill at Braddock, Pa., gas engines run several immense electric generators which furnish power to the rolling mills and other machinery, and these gas engines are operated by blast furnace gas. In addition, the American Steel & Wire Company, which is an underlying company of the Steel Corporation, is now equipping the plant at Worcester, Mass., with an 800-hp gas engine to operate the mill machinery. All of these gas engines are manufactured by the Westinghouse Machine Co., of East Pittsburg, Pa., which firm makes a specialty of their production, and produces gas engines as large as 5,000 hp.

FEED-WATER REGULATORS.—The Williams Gauge Company, Pittsburg, Pa., has recently sold safety feed-water regulators to the Illinois Central R. R., 1,200 hp; D. L. & W. R. R., 25,000 hp; Republic Iron & Steel Co., 15,000 hp; Tenn. Coal, Iron & R. R. Co., 10,000 hp; Pennsylvania Coal Co., 7,000 hp; American Car & Fdry. Co., 9,000 hp; Morgan Engineering Co., 2,000 hp; Westinghouse Elec. & Mfg. Co., 2,000 hp; New York Central & Hudson River R. R., 3,000 hp; Pullman Palace Car Co., 2,000 hp; Illinois Steel Co., 4,000 hp; Carnegie Steel Co., 3,000 hp; Crucible Steel Co., 4,000 hp; Boston & Maine R. R., 12,000 hp. The total boilers equipped to date with the Williams Safety Feed Water Regulators will, it is stated, aggregate 4,100,000 hp. An office of the company has recently been opened in Montreal, which will be conducted by Mr. Wm. M. Courtenay. This is the third office in the Dominion of Canada now operated by this company to handle the business coming to it from that country.

GENERAL ELECTRIC OFFICES IN SAN FRANCISCO.—The General Electric Company, which established its main office in the Union Savings Bank Building at Oakland, Cal., immediately after the San Francisco disaster, as well as a local office at No. 1759 Geary Street, in the burned city, has already leased a suite of rooms in the new Monadnock Building, which it expects to occupy about June 15, 1907. For handling the present business, a half a block of land has been leased in Emeryville in close proximity to both the Santa Fe and Southern Pacific Railroad tracks. A temporary building is now about completed on this land for taking care of stock, and work has already been started on a new warehouse, containing about 80,000 sq. ft., which will be located at the south end of the block, bounded by Kansas, Rhode Island, 15th and Alameda Streets. At the temporary warehouse, forty cars of material have been housed and nineteen cars of additional apparatus are now in the yards waiting to be unloaded, with thirty or forty more cars en route from Schenectady. Additional cars are being shipped from the company's factories so that the stock at San Francisco will soon be complete. At present the company is in excellent condition to fill orders as rapidly as before the fire.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 5, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

822,234. MAGNETIC CUT-OUT APPARATUS; Leonard Andrews, Hastings, England. App. filed Mar. 13, 1901. A magnetic cut-out having an armature journalled between four pole pieces which are so wound that the armature moves in different directions when the current is reversed through the cut-out. This armature is connected to a trip which permits the switch lever to move whenever the polarity is reversed.

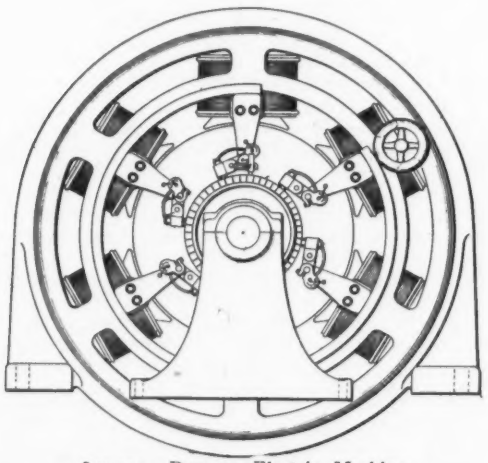
822,237. ELECTRIC SWITCH; Charles S. Barkelew, Middletown, O. App. filed Nov. 11, 1904. A switch lever has a pair of metallic clips thereon which embrace an ordinary tubular fuse through which the current passes instead of through the blade as in the usual construction.

822,240. ARC LAMP; Samuel H. Blake, Jersey City, N. J., and George R. Davison, Pittsfield, Mass. App. filed Sept. 22, 1904. The clip for holding the lower carbon is formed of a metallic piece which is bent to surround the carbon and has a pair of ears which are secured together by a screw. These ears are connected to the depending frame of the arc lamp. A set screw is used to hold the carbon in place.

822,250. ELECTRIC CABLEWAY SYSTEM; Maxwell W. Day, Schenectady, N. Y. App. filed Jan. 6, 1905. A device for keeping the traction cable taut when coaling vessels at sea. For this purpose the traction cable is connected to a hoisting motor at each of its ends, and its movement is produced by varying the relative e.m.f. of the two motors.

822,269. MOTOR STARTING RHEOSTAT; Henry Heisenhoner, Schenectady, N. Y. App. filed June 10, 1905. A pivoted arm is hollow and has a plurality of contacts therein of varying length. The arm also contains mercury which closes circuit with the contacts in succession, so that the resistance of the rheostat is gradually cut out as the arm is turned.

822,270. ELECTRICALLY HEATED HOLLOW BODY; Ernst Haagn, Hanau-on-the-Main, Germany. App. filed July 7, 1905. A resistance element for heating muffles having a piece of wire netting or fabric wound spirally round the muffle and traversed by the current. The purpose of having a fabric instead of a single wire is to avoid destruction by fusing. The network will stand a higher temperature than a simpler wire.



822,304.—Dynamo Electric Machine.

822,275. SYSTEM OF MOTOR CONTROL; George H. Hill, Schenectady, N. Y. App. filed Nov. 17, 1904.

822,282. SYSTEM OF MOTOR CONTROL; Sigvald Krohn, Berlin, Germany. App. filed Jan. 25, 1904.

822,290. STARTING RHEOSTAT; David Miller, Schenectady, N. Y. App. filed Nov. 29, 1904. A resistance box having a plurality of vertically projecting fingers and a lever arm which closes a circuit successively therewith when it is moved into horizontal relation. A magnet is provided for holding the lever down as long as the line voltage is applied.

822,293. TRANSFORMER; Walter S. Moody, Schenectady, N. Y. App. filed Nov. 18, 1904. Relates to the details of an oil transformer having the usual coils suspended in a tank containing oil. The invention particularly relates to the method of making the high potential connections which are led through the top of the box in specially constructed sleeves. These are jointed in such a way as to permit convenient assembling or dissembling.

822,304. DYNAMO ELECTRIC MACHINE; Robert H. Rogers, Schenectady, N. Y. App. filed Nov. 30, 1904. An ignition device for explosion engines capable of having a substantially uniform voltage regardless of the speed of the engine. For this purpose one of the brushes of the generator is capable of being annularly moved so as to receive a smaller percentage of the dynamo e.m.f.

822,305. PRODUCTION OF STEEL CONTAINING TITANIUM; Auguste J. Rossi, New York, N. Y. App. filed May 20, 1904.

822,311. ALTERNATING-CURRENT MOTOR; Charles P. Steinmetz, Schenectady, N. Y. App. filed Sept. 26, 1904.

822,312. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 12, 1904. A rheostat having two parallel coils each wound with bare wire and a central rod on which is mounted a sliding brush or bridge having blades capable of contacting with both of said coils.

822,314. RAILWAY SIGNALING SYSTEM; Jacob B. Struble, New York, N. Y. App. filed July 13, 1904. A railroad signal system having storage batteries which are connected to the track rails through a Ruhmkorff coil. In this way the track rails are energized to an alternating difference of potential. The storage battery also has connections to a direct current magnet operating the semaphore signal. This circuit is closed by short circuiting the track rails.

822,319. PORTABLE POTENTIAL-INDICATOR; John B. Taylor, Schenectady, N. Y. App. filed June 10, 1905.

822,323. THERMOSTATIC CONTROL; Elihu Thomson, Swampscott, Mass. App. filed Oct. 1, 1904.

822,325. CONTACT DEVICE; Knut Tornberg, Lynn, Mass. App. filed Nov. 3, 1904. In order to overcome the defect which has been found in those contact devices where a mercury globule flows from one end of a tube to the other the patentee provided a glass tube of special shape, which when rotated impels the mercury globule always in the same direction to make the contacts. This overcomes the defect hitherto found, namely, that of the mercury sticking to the glass.

822,332. INDUCTION-COIL; Montraville M. Wood, Schenectady, N. Y. App. filed Nov. 15, 1904.

822,336. THERMAL CUT-OUT FOR ELECTRIC CIRCUITS; James C. Armor, Pittsburg, Pa. App. filed June 8, 1903. A device for use with glower lamps and particularly in connection with the heater thereof. The heater has a cavity with a fusible material therein, said cavity being closed by a plug attached to a circuit wire and when the heater becomes warm the plug is expelled and the heating circuit broken.

822,345. CONTROLLING ALTERNATING-CURRENT MOTORS; Frank E. Case, Schenectady, N. Y. App. filed Jan. 25, 1904.

822,365. METHOD OF APPLYING TERMINALS TO THE GLOWERS OF ELECTRIC LAMPS; Marshall W. Hanks, Pittsburg, Pa. App. filed Mar. 23, 1901. A method for attaching the terminals of glowers of Nernst and similar lamps. The patentee fuses platinum globules to the ends of the metal by an arc lamp and then attaches the terminal wires to the platinum by fusing them in oxy-hydrogen flame.

822,376. SYSTEM OF APPLYING ALTERNATING-CURRENT ELECTRICAL ENERGY; Benjamin G. Lamme, Pittsburg, Pa. App. filed Sept. 22, 1904.

822,464. INCLOSING CASE FOR TELEPHONE SETS; Frank R. McBerty, Evanston, Ill. App. filed Dec. 10, 1904.

822,466. SIGNALING SYSTEM FOR PARTY TELEPHONE-LINES; James L. McQuarrie, South Orange, N. J. App. filed Jan. 29, 1903.

822,469. TERMINAL CONNECTOR; Joseph Opitz, New York, N. Y. App. filed Feb. 23, 1904. A plan for attaching the connection wires to electromagnets so as to avoid their being broken off in use. A disc is perforated with a pair of holes through which metallic legs project and the wires are wrapped around these metallic legs so that they will not become broken.

822,470. TELEPHONE-TRANSMITTER OR AUDIPHONE-RECEIVER; Hermann G. Pape, New York, N. Y. App. filed June 16, 1904.

822,492. BRIDGING-CONNECTOR AND TELEPHONE-LINES; Maurice C. Turner, New York, N. Y. App. filed Dec. 22, 1904.

822,508. RAILWAY TRAFFIC CONTROLLING APPARATUS; Clyde J. Coleman, New York, N. Y. App. filed Dec. 4, 1905. Relates to the circuits and details of a railroad signal system operated by the short circuiting of the track rail sections which are energized by an alternating current.

822,579. ELECTRIC SYSTEM OF TRANSMISSION; Charles G. and Edward J. Burke, Brooklyn, N. Y. App. filed Jan. 9, 1904. Relates to wireless telegraphy and includes a special system of relays by which the signals are transmitted and received at the stations.

822,590. DISTRIBUTING-BOARD; Franz J. Dommerque, Chicago, Ill. App. filed Oct. 11, 1902.

822,610. LIGHTNING-ARRESTER; Thomas J. Johnston, Brooklyn, N. Y. App. filed July 11, 1901.

822,611. MULTIPLE SWITCHBOARD FOR TELEPHONE-EXCHANGES; Milo G. Kellogg, Chicago, Ill. App. filed Apr. 24, 1893.

822,625. RAILWAY SIGNAL APPARATUS; Emil L. Nolting, Elgin, Ill. App. filed Sept. 18, 1905. In order that an engineer may know the condition of a switch in advance of his train, a circuit is made to a rail adjacent the track when the switch point is in open relation, and a trolley on the engine engages this rail and rings an alarm bell in the locomotive cab.

822,626. RAILWAY SIGNAL-APPARATUS; Emil L. Nolting, Elgin, Ill. App. filed Feb. 16, 1906. Relates to modifications of the above.

822,642. WOOD STRAIN INSULATOR; Thomas C. White, St. Louis, Mo. App. filed Aug. 7, 1905. A strain insulator having a wooden bar with conical ends with their apexes toward one another. The conical ends are enclosed by two-part clamps which are riveted together and have eyes for connection with the line wires.

822,697. DYNAMO-ELECTRIC MACHINE; William Stanley, Great Barrington, Mass. App. filed May 25, 1905.

822,709. TROLLEY STAND; John Zielinski, Detroit, Mich. App. filed Oct. 22, 1903. A trolley support comprising a pivoted arm having a spring impelled block sleeved thereon and link connections from said block whereby the spring action produces an angular movement of the pole.

822,715. BELL BOX; Sidney A. Beyland, Elyria, O. App. filed May 17, 1904. Details of construction of a telephone bell having a permanent magnet and an armature pivoted adjacent thereto so as to have uniform polarity. This armature connects with the bell clapper in the usual way.

822,719. TELEPHONE-CALL METER; Charles T. Bradshaw, Philadelphia, Pa. App. filed Oct. 3, 1903.

822,845. TROLLEY WHEEL; George W. Jobe, Indianapolis, Ind. App. filed June 23, 1905. The trolley wheel is made with a number of radial fingers each of which is capable of movement in an axial direction. These fingers close over the trolley wire in passing.

822,873. PROCESS OF COATING ONE METAL WITH ANOTHER AND THE RESULTING PRODUCT; Samuel H. Thurston, Newark, N. J. App. filed Apr. 1, 1905.

822,881. ELECTRICAL PIANO PLAYING MECHANISM; Carl E. Brown, Columbus, O. App. filed June 5, 1905. Details of construction of an electrical piano player having a perforated strip which allows the suitable electric contacts to be made and magnets which are connected by a special lever arrangement with the piano keys.

822,888. VISUAL-SIGNAL-RECEIVING SYSTEM; Ernest A. Faller, New York, N. Y. App. filed July 28, 1903.